Department of the Air Force

FINAL ENVIRONMENTAL PLANNING TECHNICAL REPORT

UTILITIES

January 1984

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Environmental Planning Division
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FINAL ENVIRONMENTAL PLANNING
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PREFACE

The President has directed that the Air Force deploy the Peacekeeper missile system at a location near F.E. Warren Air Force Base (hereafter F.E. Warren AFB), close to Cheyenne, Wyoming. The Peacekeeper system (formerly known as the M-X system) is an advanced, land-based intercontinental ballistic missile. The plan calls for the replacement of 100 existing Minuteman III missiles with 100 Peacekeeper missiles. Existing missile silos will be used, and there will be very little structural modification needed. Missile replacement will occur within the two squadrons (of 50 missiles each) located nearest F.E. Warren AFB, the 319th and 400th Strategic Missile Squadrons. Peacekeeper deployment will occur between 1984 and 1989.

An environmental impact statement (EIS) was prepared for the Proposed Action as outlined above. Information contained in the EIS is based upon environmental information and analysis developed and reported in a series of 13 final environmental planning technical reports (EPTRs). This volume is one of those reports. The 13 resource areas are:

- Socioeconomics (employment demand, housing, public finance, construction resources, and social well-being);
- Public Services and Facilities;
- Utilities;
- Energy Resources;
- Transportation;
- Land Use (land use, recreation, and visual resources);
- Cultural and Paleontological Resources;
- Water Resources;
- Biological Resources;
- Geologic Resources;
- Noise;
- Air Quality;
- Jurisdictional.

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INTRODUCTION

1.0 INTRODUCTION

This final environmental planning technical report (EPTR) is a companion document to the utilities section of the final environmental impact statement (FEIS) for the Peacekeeper in Minuteman Silos project. It provides data, methodologies, and analyses which supplement and extend those presented in the FEIS.

This final EPTR consists of six major sections. Section 1.0 provides an overview of the Peacekeeper in Minuteman Silos project and a description of the utilities resource and its elements.

Section 2.0 presents a detailed description of the environment potentially affected by the project. It includes a capsule description of the environmental setting (Section 2.1) and project requirements (Section 2.2). Section 2.3 defines the Region of Influence and Area of Concentrated Study for the resource. Section 2.4 (Derivation of Data Base) follows with a discussion of the literature sources, group and agency contacts, and primary data which provide the data base for the report. Section 2.5 describes analytic methods used to determine existing environmental conditions in the Region of Influence. Detailed analyses of the existing environment, broken down by constituent elements of the resource, follow in Section 2.6.

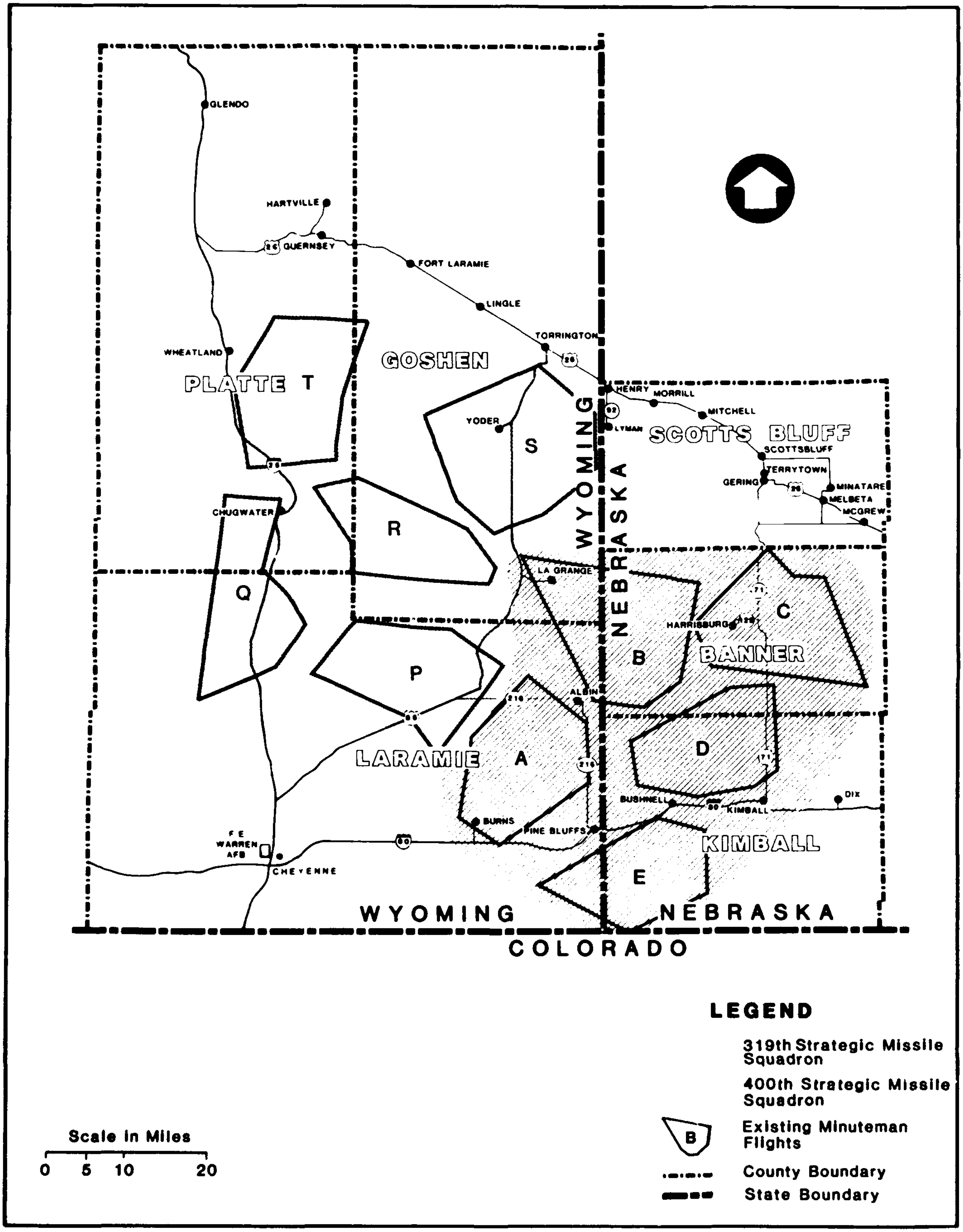
Section 3.0 describes environmental consequences of the Proposed Action and its project element alternatives, the No Action Alternative, mitigation measures, and unavoidable impacts. It contains detailed definitions of each potential level of impact (negligible, low, moderate, and high) for both short-term and long-term impacts. Beneficial effects are also discussed. Definitions of significance are also included. Methods used for analyzing future baseline and project impacts are described, as are assumptions and assumed mitigations. Additional mitigation measures to reduce project impacts are also described.

Sections 4.0 (Glossary), 5.0 (References), and 6.0 (List of Preparers) conclude the EPTR.

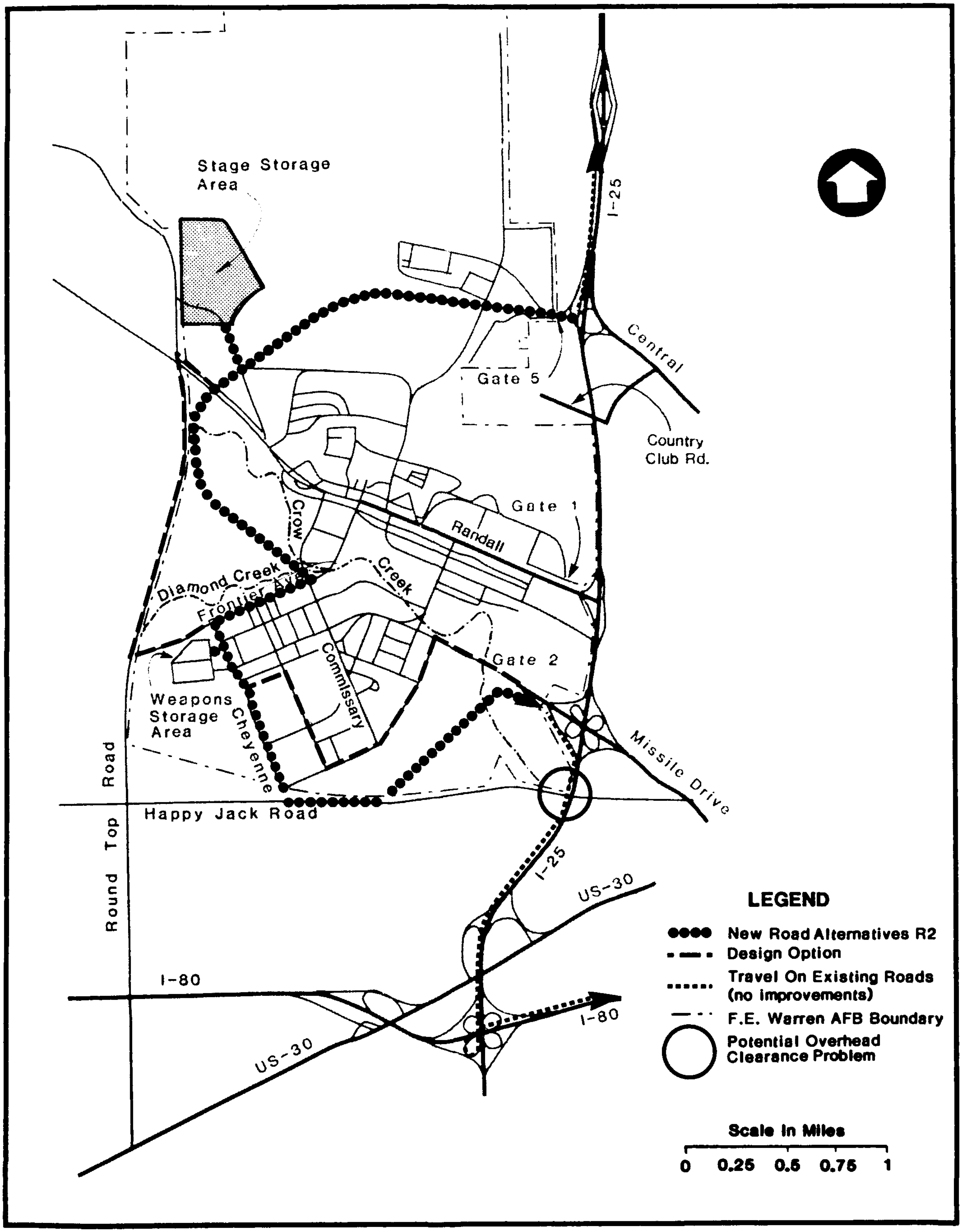
1.1 Peacekeeper in Minuteman Silos

The Peacekeeper system, which the Air Force plans to deploy within the 90th Strategic Missile Wing at F.E. Warren Air Force Base (AFB), Wyoming, is an advanced land-based intercontinental ballistic missile system designed to improve the nation's strategic deterrent force. Deployment of the Peacekeeper calls for replacement of 100 existing Minuteman III missiles with 100 Peacekeeper missiles. Missile replacement will occur in the 319th and 400th Strategic Missile Squadrons, located nearest F.E. Warren AFB (Figure 1.1-1). The Deployment Area covers parts of southeastern Wyoming and the southwestern Nebraska Panhandle.

Construction at F.E. Warren AFB will occur between 1984 and 1986. Fourteen new buildings will be constructed, and modifications or additions will be made to 11 existing buildings. Approximately 400,000 square feet of floor space will be built or modified. A new road configuration, to be selected from three alternatives, is proposed to link Peacekeeper facilities onbase and to provide improved access to or from the base (Figures 1.1-2, 1.1-3, and 1.1-4).

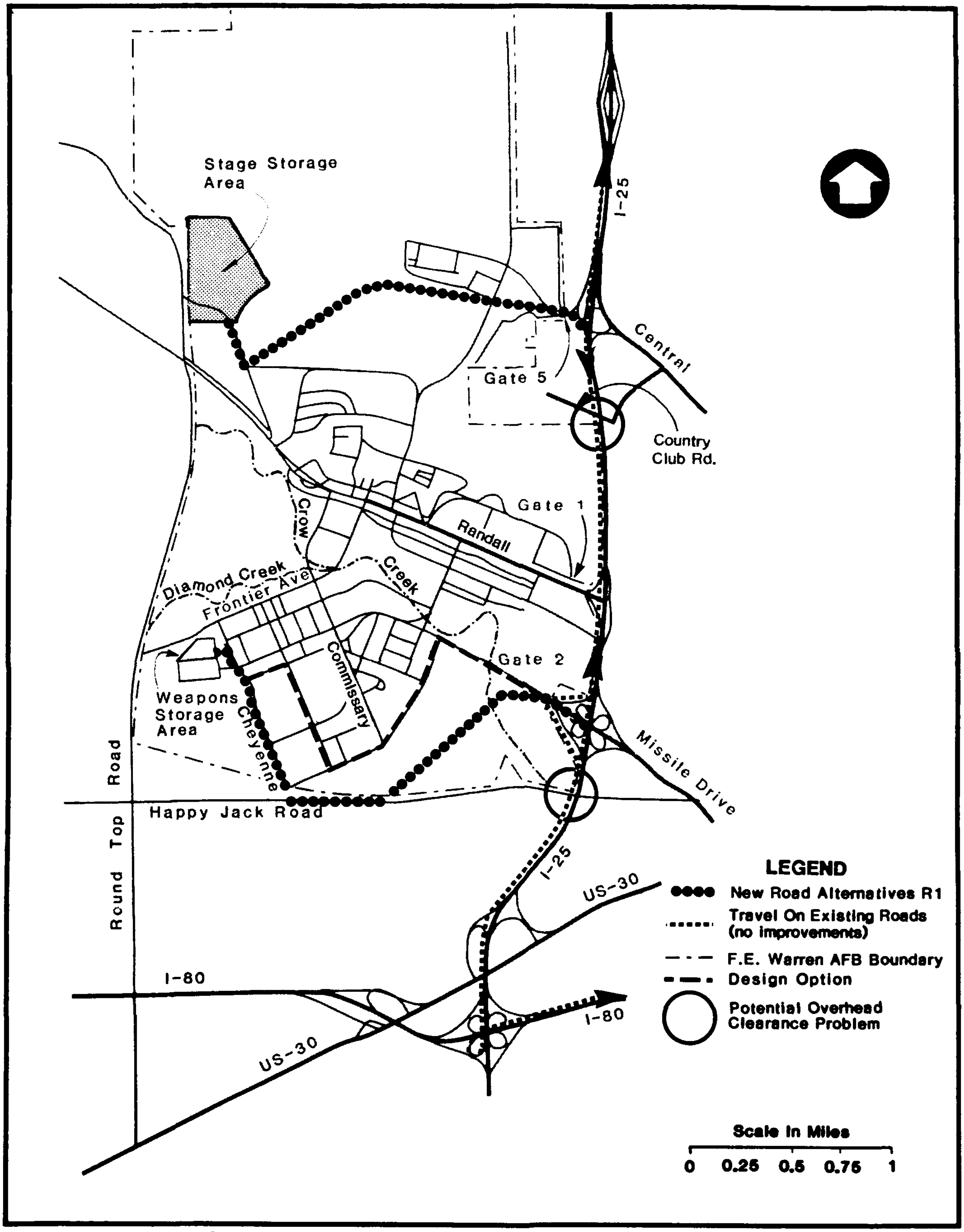


PEACEKEEPER DEPLOYMENT AREA FIGURE NO. 1.1-1



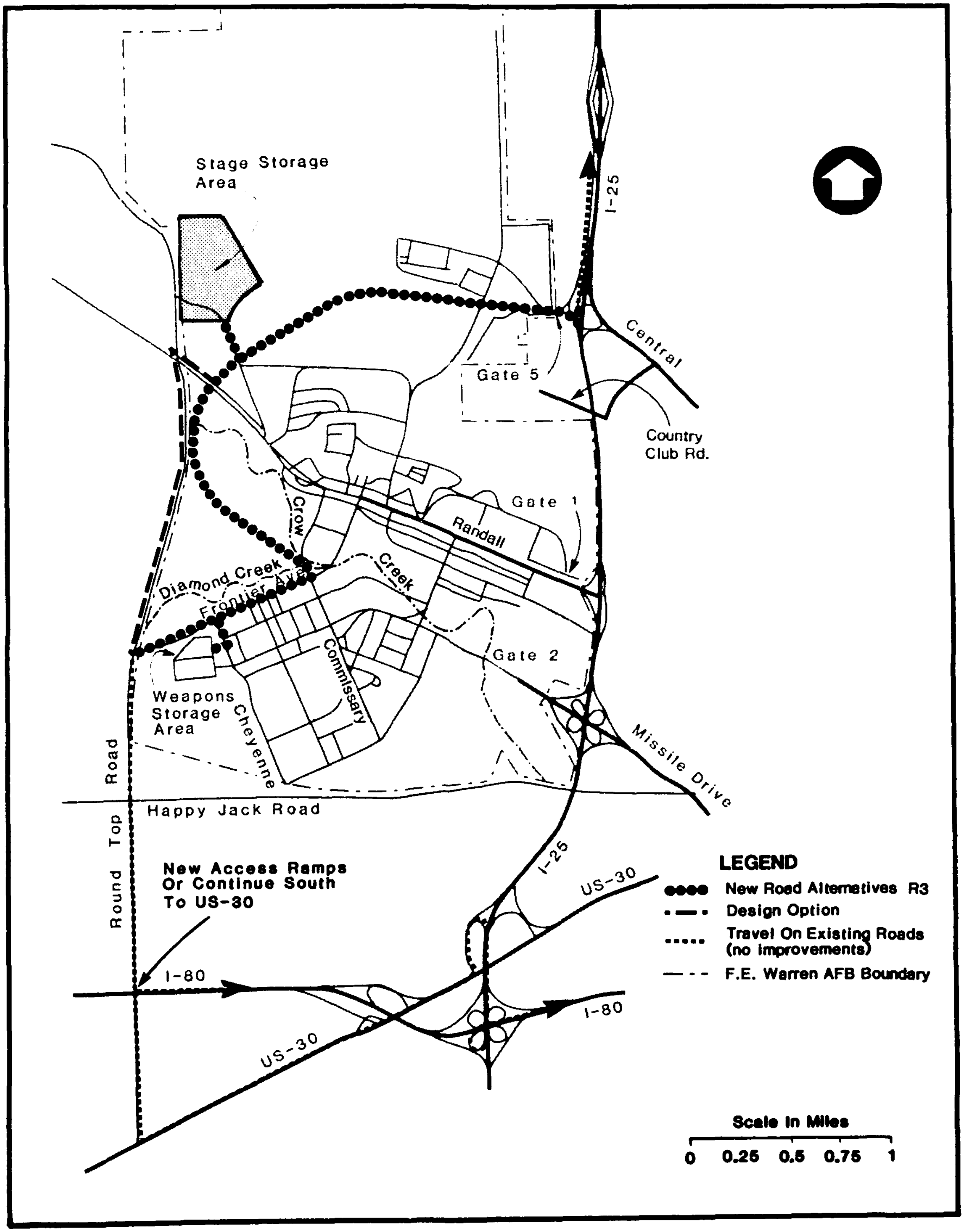
NEW ROADS AT F.E. WARREN AFB:
PROPOSED ACTION R2

FIGURE NO.
1.1-2



NEW ROADS AT F.E. WARREN AFB:
ALTERNATIVE R1

FIGURE NO.
1.1-3



NEW ROADS AT F.E. WARREN AFB:
ALTERNATIVE: R3

FIGURE NO.
1.1-4

Work in the Deployment Area will take place between 1985 and 1989. Many of the access roads to the Launch Facilities will be upgraded. Bridge clearance problems will be corrected, and some culverts and bridges may need to be upgraded. Below-ground modifications will be related to removal of Minuteman support hardware, insertion of a protective canister to enclose the Peacekeeper, and installation of communications systems and support equipment.

A total of 11 alternatives have been chosen as candidate routes for communication connectivity between Squadrons 319 and 400 (Figure 1.1-5). Five routes will be selected for installation. Total buried cable length will range from approximately 82 to 110 miles, depending on final route selections.

Under the Proposed Action two dispatch stations would be established, one each in the northern and eastern portions of the Deployment Area. Although actual locations have not been selected, Chugwater, Wyoming and Kimball, Nebraska are representative locations analyzed in the Final Environmental Impact Statement and in this EPTR. Dispatch stations would be not more than 5 acres in size and would be used for the temporary open storage of equipment and material. One or more buildings would also be present at each site for contractor use as office space. All dispatch stations would be removed prior to project completion. In addition to the Proposed Action, two alternatives are considered in this environmental impact assessment:

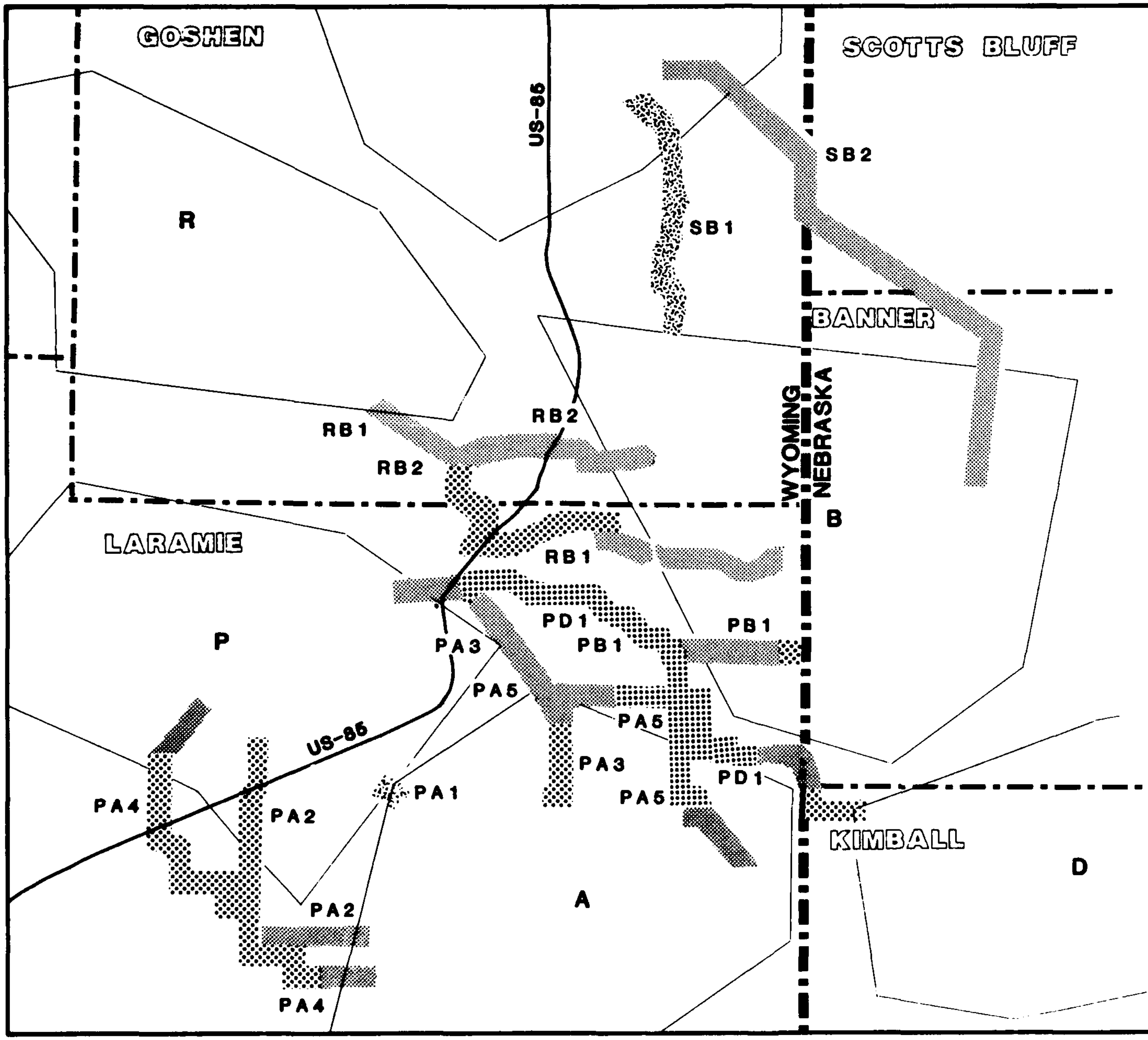
1) One dispatch station only, in the eastern part of the Deployment Area; or

2) No dispatch stations.

Two options have been identified for resurfacing Deployment Area roads. Surfacing Option A involves gravel upgrades of 252 miles of existing gravel roads and the paving or repaving of 390 additional miles of gravel and asphalt roads. Surfacing Option B involves the paving or repaving of all 642 miles of gravel and asphalt roads listed in Surfacing Option A.

Direct manpower for construction, assembly and checkout, and operation of the system will peak during 1986 when an average of nearly 1,600 persons will be required. In 1991, following deployment, the remaining increased operational workforce at F.E. Warren AFB will consist of about 475 persons. Table 1.1-1 presents the average annual workforce, based on quarterly estimates for each year of construction.

Table 1.1-2 shows the average number of jobs including those which are considered to be filled by available labor, as well as those filled by weekly commuters and inmigrants, on an annual average basis. In general, locally available labor will fill all the road and construction jobs.



CABLE ROUTE DISTANCES

Cable	Distance in Miles
PA2	14
★RB1	23
PB1	19
PD1	27
PA3	14
★PA4	22
SB2	26
★PA1	1
★SB1	12
★PA5	24
RB2	13

ALTERNATIVE CABLE ROUTES

FIGURE 1.1-5

Table 1.1-1

PROJECT AVERAGE MANPOWER REQUIREMENTS BY YEAR[1]

	1984	1985	1986	1987	1988	1989	1990	1991
Deployment Area								
Construction	5	40	60	60	40	0	0	0
Assembly and Checkout	0	15	210	285	265	265	10	0
Operations	0	0	0	0	0	0	0	0
Defense Access Road	0	275	315	150	0	0	0	0
Subtotal	5	330	585	495	305	265	10	0
Operating Base								
Construction	100	630	70	0	0	0	0	0
Assembly and Checkout	40	130	525	555	515	510	22	0
Operations	0	130	415	490	500	500	475	475
Subtotal	140	890	1,010	1,045	1,015	1,010	497	475
TOTAL:	145	1,220	1,595	1,540	1,320	1,275	507	475

Note: [1] Estimates based on average quarterly employment.

Table 1.1-2

TOTAL JOBS, LOCAL AND REGIONAL HIRES, AND INMIGRATION FOR THE EMPLOYMENT DEMAND REGION OF INFLUENCE

	1984	1985	1986	1987	1988	1989	1990	1991 and beyond
1) Total (Direct/ Indirect) Additional Jobs	250	2,400	2,675	2,550	2,025	1,825	650	590
2) Average Annual Local Hires	150	1,750	1,525	1,350	1,100	815	225	230
3) Average Annual Weekly Commuters	25	225	175	100	25	10	0	0
4) Average Annual Inmigrant Workers	75	425	950	1,100	925	1,000	425	360
5) Unsuccessful Job-Seekers	30	185	180	150	165	110	70	0
6) Inmigrant[1] Population	275	1,475	2,875	3,200	3,025	2,875	1,200	925

Note: [1] Includes inmigrants, workers, and unsuccessful job-seekers.

As a result of the purchase of materials in the project area and local expenditures of project employees, additional jobs will be created in the region. These jobs are estimated to number as follows:

Year:	1984	1985	1986	1987	1988	1989	1990	1991 and beyond
Indirect Jobs:	105	1,180	1,080	1,010	705	550	143	115

Estimated materials and costs for the project, based on total project budgetary considerations, are shown by Standard Industrial Classification in Table 1.1-3.

A number of construction and support materials will be obtained from sources within the project area. Among the materials exerting a major influence on assessment of project impacts are aggregate (4.6 million tons), water (516 acre-feet), fuel (7.6 million gallons), and electricity (3.8 million kWh). In the case of water supply for construction, the Air Force will identify and, if necessary, obtain permits for the water or purchase existing water rights.

1.2 Description of Resource

The term utilities, as used here, includes facilities provided in towns and cities for water treatment and distribution, wastewater collection and treatment, storm drainage, solid waste collection and disposal, and telephone service.

Table 1.1-3

ESTIMATED MATERIAL REQUIREMENTS
BY STANDARD INDUSTRIAL CLASSIFICATION

Industrial Classification	Estimated 1982 Dollars (1,000s)
Fabricated Structural Metal	$22,999
Unclassified Professional Services and Products	14,358
Cement and Concrete Products	10,862
General Wholesale Trade	8,890
Structural Metal Products[1]	11,983
Millwork, Plywood, and Wood Products[1]	3,941
Copper, Copper Products	3,902
Electrical Lighting and Wiring	3,871
Stone and Clay Mining and Quarrying[1]	39,728
Stone and Clay Products[1]	2,955
Basic Steel Products	1,233
Heating and Air Conditioning Apparatus	1,525
Plumbing and Plumbing Fixtures	938
Petroleum Refining and Products	5,148
Material Handling Equipment	1,970
Sawmills and Planing Mills	1,478
Paints and Allied Products[1]	1,478
Plastic Products[1]	1,478
Furniture and Fixtures	986
Structural Clay Products	986
General Hardware	986
Scientific Instruments	986
Rail Transport	986
Real Estate	986
Construction, Mining, and Oilfield Machinery	749
TOTAL:	$145,402

Note: [1] Not included in other Industrial Classifications.

AFFECTED ENVIRONMENT

2.0 AFFECTED ENVIRONMENT

2.1 General

Throughout the study region, utilities services other than telephone service are generally provided by town and city governments. Telephone service is provided by private companies.

Water is supplied from a mixture of well and surface water sources. Wastewaters are collected everywhere in separate sewer systems. There are very few combined sewer systems for storm runoff and sanitary wastewaters. Storm drainage is provided through storm sewer systems in portions of communities and is provided through a mixture of roadway swales, culverts, roadside ditches, and the like in other portions. Solid wastes are collected by both private, commercial haulers and by city-owned fleets of garbage trucks. Most disposal sites for garbage are community-owned and operated. Telephone service throughout the region is provided by either Mountain Bell, the Chugwater Telephone Company, or United Telephone Company of the West.

The balance of this chapter describes in detail the utilities existing throughout the area of study.

2.2 Project Requirements

Overall project requirements were outlined in Section 1.1. Direct and indirect requirements specific to utilities are as follows.

2.2.1 Direct Project Requirements

With respect to this work, there are two direct project requirements. There is a need for disposal of roughly 600 cubic yards (cy) of construction-related solid waste to be generated during the construction phase at F.E. Warren Air Force Base (AFB). And there is a temporary need for 600 to 800 telephones at the base.

All other utility requirements relate to indirect worker and service population needs for community facilities and services.

2.2.2 Indirect Project Requirements

Most utility needs related to the project are those associated with inmigrant population requirements for municipal services.

In virtually all affected communities, existing facilities for treatment and distribution of water supplies, wastewater disposal, stormwater facilities, solid waste disposal, and telephone service are adequate to handle the needs of all anticipated inmigrant populations. A few exceptions exist.

For wastewater treatment, the Cheyenne area and Pine Bluffs are experiencing capacity difficulties with existing plants.

For solid waste disposal, only the city of Cheyenne will require some additional collection and disposal-site compaction equipment.

For stormwater facilities, the Cheyenne region will require new storm sewer networks to accommodate baseline plus project-induced growth. Ordinances mandating these provisions by developers of new land are in place.

For telecommunications service and water treatment and distribution, higher community demands will occur, but existing infrastructures and facilities can absorb the added demands.

2.3 Region of Influence

2.3.1 Definition

The Region of Influence (ROI) for utilities includes the counties in two states where inmigrating populations have been projected, as well as all the counties in which deployment will occur. This area includes the six counties shown in Figure 2.3.1-1. The ROI is the same for all elements (water, wastewater, solid waste, storm drainage, and telephones).

Much smaller Areas of Concentrated Study (ACS) were selected for concentrated analytical attention. They include those towns, cities, and special districts to which the inmigrant populations have been allocated. These include Cheyenne, Chugwater, Pine Bluffs, Torrington, and Wheatland, Wyoming; and Gering, Kimball, and Scottsbluff, Nebraska. They are shown in Figure 2.3.1-2.

Other than the region around Cheyenne, the extent of the ACS communities is defined by their corporate boundaries. The Cheyenne Urban Area for utilities is defined as:

- The city limits of the City of Cheyenne;
- The South Cheyenne Water & Sewer District (SCW&SD), a special district south of the city;
- F.E. Warren AFB; and
- Areas north and east of the Cheyenne city limits which the Cheyenne Board of Public Utilities and others anticipate to be future growth areas that will first be annexed.

The boundary for the Cheyenne Urban Area is shown in Figure 2.3.1-3.

2.3.2 Justification

County boundaries have been used to define the ROI because regulations (such as those dealing with wells or septic tanks for individual homes and rural-area solid waste disposal sites) are administered by county jurisdictions, and because solid waste disposal sites tend to be city-owned but located in nearby unincorporated locations. Storm sewers are in individual communities, but they drain to streams that traverse entire counties. Telephone service is provided by private utilities which serve multiple counties, even though the relevant service areas for telephones fall within individual cities that lie within the county boundaries comprising the ROI. Section 3.1.7.1 provides a fuller justification for the ACS.

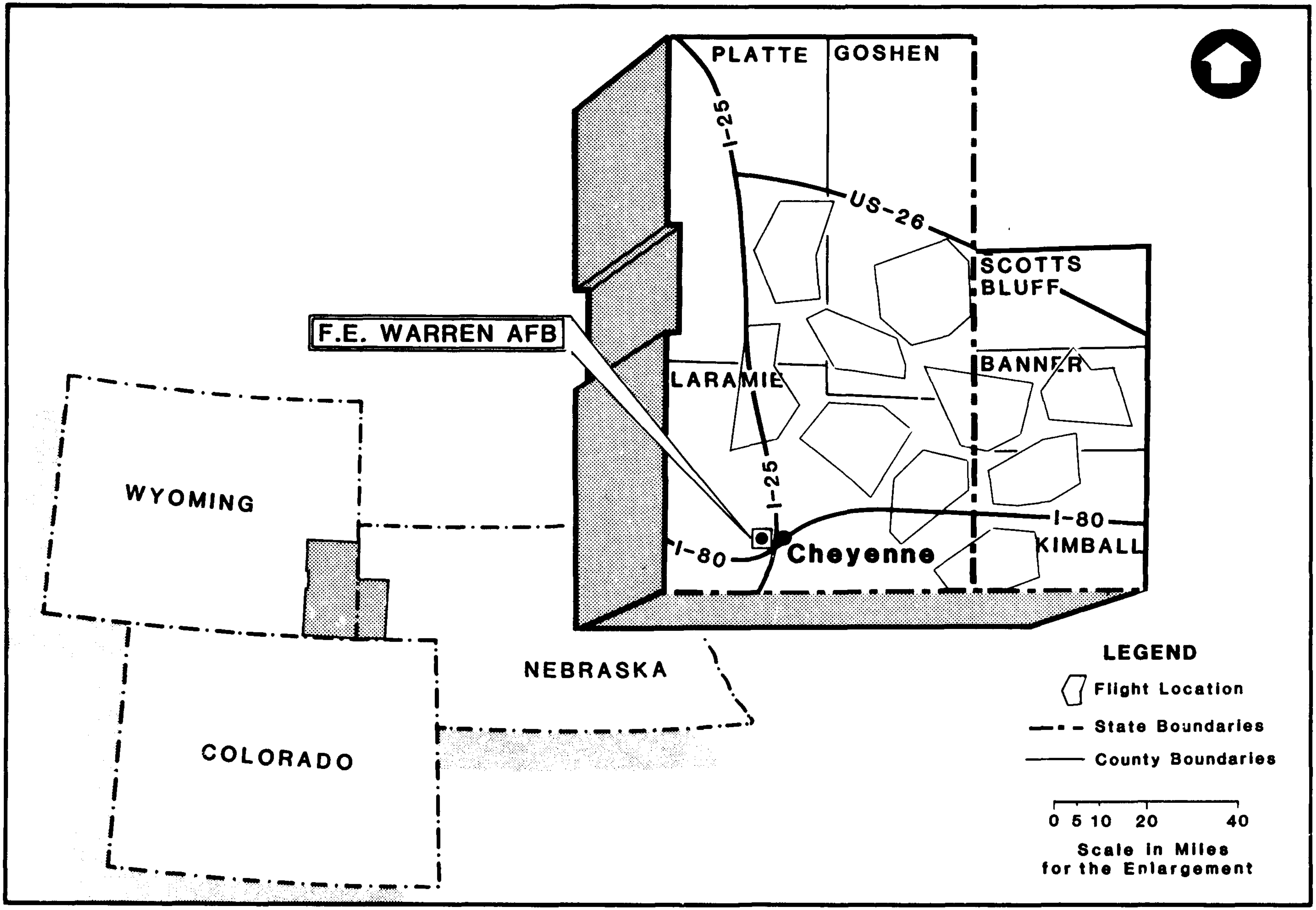


FIGURE 2.3.1-1 REGION OF INFLUENCE FOR UTILITIES

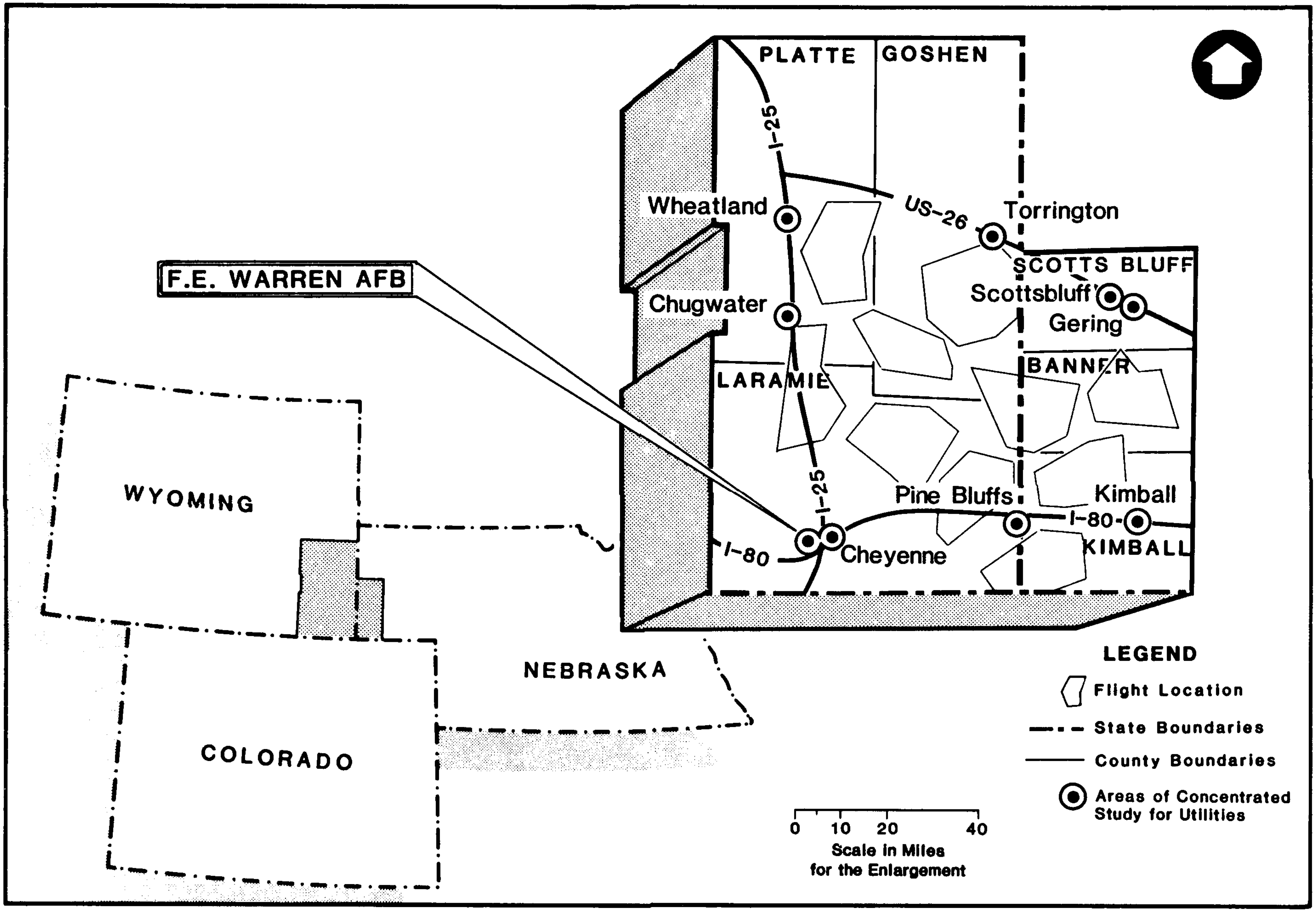


FIGURE 2.3.1-2 AREAS OF CONCENTRATED STUDY FOR UTILITIES

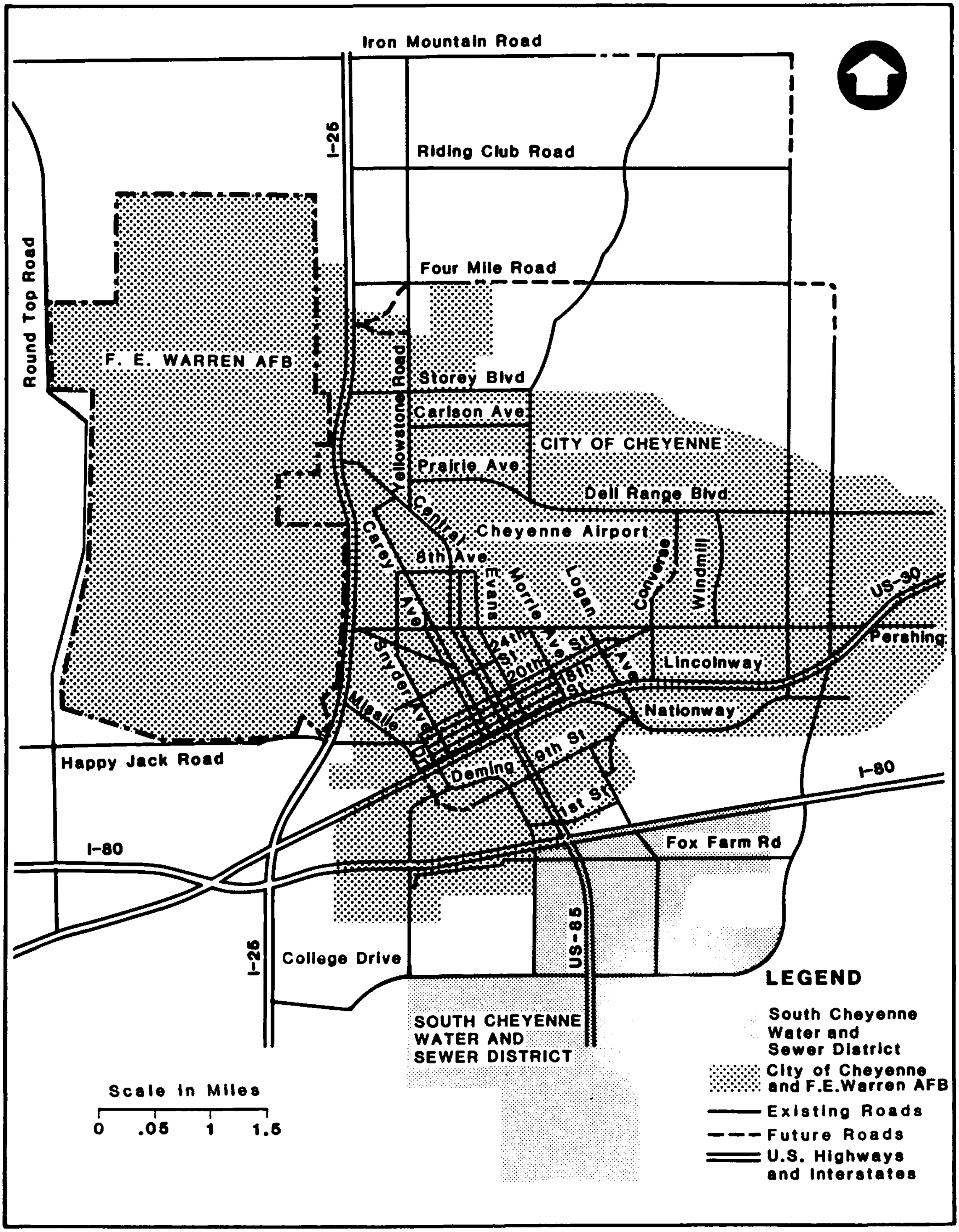


FIGURE 2.3.1-3 THE CHEYENNE URBAN AREA AS DEFINED FOR UTILITIES

2.4 Derivation of Data Base

Similar sources of data were used for all five elements. They included technical literature, local agency personnel, and one field trip to collect primary measurements. These sources are summarized below.

2.4.1 Literature Sources

Generally accepted environmental engineering texts and technical publications were used sparingly as sources of standards-of-practice to derive such things as unit water demands or runoff coefficients not available from local agencies or which could not be measured as primary data in the field. References to such publications are noted throughout, and the full bibliographic citations are given in Section 5.0.

2.4.2 Group and Agency Contacts

Public works officials were contacted in all communities in the ROI where inmigrant, project-induced populations had been allocated. (See the Socioeconomics Environmental Planning Technical Report [EPTR] for the allocation procedures.) Data were requested from these individuals to describe existing facilities and already planned future expansions or improvements.

Additionally, state officials in Wyoming and Nebraska were interviewed to obtain data on water, wastewater, and solid waste regulations and requirements for building and operating new facilities that may be necessary.

Several private service companies were also contacted to learn their current capacities. Among these were Mountain Bell Telephone Company, the United Telephone Company of the West, and several private waste haulers in the Cheyenne area.

2.4.3 Primary Data

With one exception, no utilities data were collected through field measurements. The exception was a field surveying effort in Cheyenne to determine as-built information on the sizes and slopes of existing storm sewers and a few elevations of manhole bottoms in the sanitary sewer system.

2.5 Analytic Methods for Existing Conditions

Adequacy of existing facilities was determined by comparison of capacities in place with demands for all services as reported by local officials. Where data concerning existing demand levels did not exist, current populations were multiplied by nominal unit loads (such as gallons per capita per day [gpcd]) to arrive at an estimate of existing demand conditions.

For the Cheyenne Urban Area (as defined for utilities), water, wastewater, and stormwater pipeline capacities were checked against mathematical model simulations of the existing flows in those systems. Deficiencies identified by the models were noted. Some waste treatment plants in Cheyenne and other communities were also simulated mathematically to determine the adequacy of existing plant types and sizes to treat current waste flows.

2.5.1 Water Treatment and Distribution

2.5.1.1 Cheyenne Urban Area

Personnel of the Cheyenne Board of Public Utilities (CBPU) provided information on water treatment plant operations and capacities.

The adequacy of the water distribution system's pipeline and storage capacities, especially for baseline and project-induced growth, had been questioned by CBPU and SCW&SD personnel. Accordingly, an hydraulic simulation by digital computer was first made of 1983 conditions. The same model was used again with new population-induced water demands for baseline and project-induced demand conditions in later years. This model, known as the Water System Simulation Model (WATSIM), is described in Appendix A.

2.5.1.2 All Other Communities

Interviews were held with water service departments, city engineers, or equivalent public works personnel in various cities throughout the ACS to gather data on existing water treatment plants and water distribution piping. These cities included Gering, Kimball, and Scottsbluff, Nebraska, and Torrington and Wheatland, Wyoming. Phone calls were made to obtain similar information from public works personnel in Chugwater and Pine Bluffs, Wyoming.

Information sought included sources of raw water supply (groundwater vs. surface water); the size, type, and current flows for treatment plants, if any; storage volumes available; and the sizes and current flows or pressures in water distribution systems. (Additional information supplied included service fees charged to existing customers and current or recent annual operating budgets for water-service departments.)

2.5.2 Wastewater

2.5.2.1 Cheyenne Urban Area

Intensive study was made in the offices of the CBPU and the SCW&SD to determine the sizes and slopes of existing sanitary sewers. Most of this information was extracted from old construction contract documents. Unfortunately, gaps in knowledge remain, and the entire sanitary sewer networks could not be represented.

The Storm Water Management Model (SWMM) of the U.S. Environmental Protection Agency (EPA) was applied to the identified trunk sewers to check their hydraulic adequacy to contain existing flows. Sewage flows were assigned to points in the sewer systems throughout the Cheyenne Urban Area in relation to census tract and neighborhood population distributions, land-use information, and recent per capita sewage generation rates.

CBPU personnel reported the capacities and types of the two major treatment plants in town, Crow Creek and Dry Creek. No further analyses were made, other than comparisons of operating characteristics against standards of practice.

A small plant operated by the SCW&SD is operating at capacity now. A treatment simulation model (CAPDET) was applied to that plant to determine its actual capacity as compared with the nominal design criteria the model contains.

Both mathematical models, SWMM for sewer systems and CAPDET for treatment plants, are described in Appendix A.

2.5.2.2 All Other Communities

Visits were made to interview sewage department or public works personnel in various cities throughout the Deployment Area (DA) to gather data on existing waste collection and treatment facilities. These cities included Gering, Kimball, and Scottsbluff in Nebraska, and Torrington and Wheatland in Wyoming. Phone calls to obtain similar information were made to Chugwater and Pine Bluffs, Wyoming.

Information sought included sizes and types, existing flows, and current adequacy (existence of excess capacity) for sewer systems and treatment plants.

2.5.3 Solid Waste

2.5.3.1 Cheyenne Urban Area

Interviews were held with personnel from the Division of Streets and Alleys and the Department of Sanitation in the Department of Public Works of the City of Cheyenne to learn current operating procedures for both the garbage collection fleet and the solid waste disposal site.

Additional interviews were held with state personnel in Wyoming (Water Quality Division and Solid Waste Program of the Department of Environmental Quality) to gain their insights to City and F.E. Warren AFB operations with respect to solid waste disposal and handling of toxic and hazardous substances.

Only limited data existed regarding per capita rates of solid waste generation. For purposes of this analysis, all available data were gathered, analyzed, and compared against national averages to arrive at an acceptable average generation rate. There was general agreement between the available data and the national average of 5.0 pounds of solid waste per capita per day. This was confirmed by the Waste Management Study Group Report (1983), recently prepared for the City of Cheyenne. Compacted solid waste was also estimated to weigh approximately 1,000 pounds per cubic yard (lb/cy), based on a volume reduction to 20 to 25 percent of uncompacted volume. For purposes of estimating current and future waste loads from F.E. Warren AFB, a generation rate of 2.76 pounds per capita per day (ppcd) has been applied, based on 1982 records. Waste loads for weekly commuters and transients were taken to be 3.0 ppcd.

Actual samples of solid waste produced were not collected or weighed to determine waste composition. However, field inspections of the solid waste disposal sites provided useful insight to the general composition of waste loads.

2.5.3.2 All Other Communities

Interviews were held with public works officials to obtain data concerning existing garbage collection crews and equipment, current operations, remaining lives of disposal sites, and charges for residential service. Visits were made to the disposal sites of Torrington, Wyoming, and Scottsbluff, Gering, and Kimball, Nebraska. Phone interviews were conducted for Pine Bluffs, Chugwater, and Wheatland, Wyoming.

From the data describing annual solid waste loads handled and the current populations, unit per capita loads were computed for each community. (These unit loads were subsequently found to be very near the average value of 5.0 ppcd, which was used to predict future load conditions both with and without the project.)

Remaining life of each disposal area was either given by a public works official in each community, or it was computed in this work from given information on existing areas of owned disposal sites and the current annual tonnages or volumes of wastes buried there.

2.5.4 Stormwater

2.5.4.1 Cheyenne Urban Area

The Division of Streets and Alleys in the Cheyenne Public Works Department had expressed some concern about certain existing storm sewer systems and their ability to contain relatively frequent storm runoff volumes, even under existing conditions. Moreover, officials in that office have stated that considerable useful information about the existing system, including pipe sizes and especially elevation or slope data, is simply not known. Therefore, the project provided a 10-day field surveying effort to check storm sewer sizes and invert elevations at a number of pipe manholes throughout the developed area of the city in the Crow Creek drainage basin.

Still further, computer simulations with SWMM were made for the two major storm drain subsystems for which the field data were collected. The purpose of the simulations was to determine hydraulic "trouble spots" in the existing system, if any.

2.5.4.2 All Other Communities

Only peak runoff rates were estimated for cities other than the Cheyenne Urban Area. Those results, reported immediately herein, are compared later in the report to the facilities for storm runoff now in place in each community.

Of the numerous peak-runoff prediction methods, virtually all combine factors to account for 1) a certain amount of rainfall that occurs during the design event (inches or in/hr), 2) the areal extent of the drainage-basin surface (acres), and 3) the degree to which the land surface holds or absorbs all the fallen rain water, so that runoff is less than all the rain.

The method used, known as the Rational Method, gives a peak runoff rate in cubic feet per second (cfs) as:

$$Q = CiA$$

in which Q = peak flow (cfs); C = a dimensionless runoff coefficient (0.0 to 1.0), which reduces the total rainfall to only that portion which will become runoff; i = rainfall intensity (in/hr) for a given duration of rain; and A = the drainage basin size in acres.

Runoff coefficients were derived from general values given by Steel and McGhee (1979) and from knowledge of the types of land use and general slopes of the terrain in the ACS communities.

Rainfall intensities were also derived from nationally summarized data in Steel and McGhee (1979), specifically for an area including eastern Wyoming and western Nebraska. The relationship used was for a 2-year storm, i.e., a storm that is likely to occur once every 2 years. The relationship is:

$$i = \frac{1,780}{t + 16}$$

in which i = intensity in millimeters per hour (mm/hr), which were converted immediately to inches per hour (in/hr); and t = duration of the storm involved in minutes.

From separate computations concerning land areas of various arbitrary sizes (1,000 to 5,000 acres), travel times of runoff from remotest points to outflow points were computed. These flow times are useful estimators of design storm durations (t) for which appropriate intensities should be computed. Accordingly, the duration for communities of roughly 1,000 acres was found to be about 1 hour. The duration appropriate for the 16,000-acre Cheyenne Urban Area was about 4 hours; and Scottsbluff, with 3,160 developed acres, had a design runoff duration of approximately 2 hours.

All these data, including those for the Cheyenne Urban Area, are presented in a later section in Table 2.6.4-2. The values of intensity, i, computed from (1,780/t+16), are also given in that table.

The peak flows computed from Q = CiA are also given later in Table 2.6.4-3. Also shown are several ratios of the computed peak flows to the flow carried by single pipes having the indicated diameters. These ratios express the equivalent number of storm sewers of the indicated size necessary to drain each community. As an example, a flow of 450 cfs in Gering or Kimball (or other 1,000-acre areas with a slope of 0.001 ft/ft) would require about eight 60-inch, parallel storm drains or fifteen 48-inch storm drains.

Cities typically provide storm sewers in only one-third to one-half their developed areas, usually the downtown commercial district. Therefore, also shown in Table 2.6.4-3 are fractions of the equivalent 60-inch sewers required ($N_{60}/2.5$ in Table 2.6.4-3). These values of required equivalent storm sewers are values compared later in the report to the existing facilities in each community today.

It is worth emphasizing that the indicated facilities required, which have been listed in Table 2.6.4-3 are based on gross land use and runoff coefficient estimates and are not intended to be design prescriptions. More detailed field surveys and engineering computations would be required to defend estimates of exact needs. But these estimates are sufficient for comparison purposes later herein. Table 2.5.4-1 summarizes the data used to estimate the flow rate that could be discharged through single pipes of various sizes.

2.5.5 Telephone Service

Telephone service throughout the ACS communities is provided by Mountain Bell, the Chugwater Telephone Company, and the United Telephone Company of the West. Reports provided by the companies, as well as interviews with company personnel, provided data on current usage and transmission and exchange capacities in place. These data, for the Cheyenne Urban Area and all other communities, were compared against existing population demands. Assurances that all demands were being met were confirmed.

2.6 Existing Environmental Conditions

2.6.1 Water Treatment and Distribution

Water treatment and distribution data for communities throughout the ROI are summarized in Table 2.6.1-1.

2.6.1.1 Cheyenne Urban Area

2.6.1.1.1 Water Treatment

The CBPU operates two water treatment plants, Round Top and Happy Jack. Raw surface water from Crystal Reservoir is conveyed by gravity to both treatment plants through 20-inch and 30-inch pipelines.

The initial facilities at the Round Top treatment plant were constructed between 1902 and 1911, and numerous upgrades and expansions have been made since that time. Flash mixing, sedimentation, mixed media filtration, and chlorination are provided at the plant. The CBPU has indicated that the nominal treatment capacity at Round Top is 7 million gallons per day (mgd). Treated water can be stored in three enclosed concrete basins. The total storage volume of the 3 basins at Round Top is reportedly 12 million gallons (MG) (Banner Associates, Inc. 1983).

The Happy Jack water treatment plant was constructed between 1974 and 1975 and provides the identical type of treatment as Round Top. The CBPU has indicated that the nominal treatment capacity at Happy Jack is 19 mgd. Treated water can be delivered directly into the distribution system or stored in the 5 MG King Reservoir, 0.5 mile east of the plant.

The CBPU can supplement the supply of treated water to the distribution system with groundwater from three wellfields - Federal, Bell, and Main. Groundwater from the Federal wellfield is pumped to the Round Top storage reservoir. Bell and Main wellfield waters can be pumped either to the Round Top storage reservoir or to King Reservoir where they are chlorinated and mixed with the

Table 2.5.4-1

ELEMENTS OF COMPUTATION FOR FLOWS
IN STORM SEWERS OF VARIOUS DIAMETERS

Pipe Diameter, d, inches (feet)	Roughness Coefficient, n, $feet^{1/6}$	Cross-Sectional Area, $A=\pi d^2/4$, ft^2	Hydraulic Radius, R=d/4, ft	$R^{2/3}$	Pipe Slope, S, ft/ft	$S^{1/2}$	Design Flow, Q_d[1], cfs
60 (5)	0.02	19.6	1.25	1.16	0.001	0.0316	53.5
48 (4)	0.02	12.6	1.00	1.00	0.001	0.0316	29.5
24 (2)	0.02	3.14	0.50	0.63	0.001	0.0316	4.65

Note: 1 $Q_d = \frac{1.486}{n} AR^{2/3}S^{1/2}$ (Manning Equation)

$Q_d = f(1/n)$ = inverse function of the roughness coefficient.

$Q_d = f(S^{1/2})$ = direct function of the square root of pipe slope.

$Q_d = f(AR^{2/3}) = f(d^{8/3})$ = direct function of characteristics of pipe diameter, which was given (d).

$Q_d = 0.732d^{8/3}$ for n=0.02 and S=0.001.

Table 2.6.1-1

WATER TREATMENT AND DISTRIBUTION INFORMATION FOR COMMUNITIES IN THE REGION OF INFLUENCE

Community	1983 Service Population	Average-Day Demand, mgd	Peak-Day Demand[2], mgd	Treated-Water Storage Capacity, MG	Surface Water Treatment Capacity, mgd[1]
Cheyenne Urban Area	58,954	12.8	33.5	22.0	26
Chugwater, WY	4,520	-	-	-	-
Gering, NE	8,560	2.7	6.5	1.2	0
Kimball, NE	3,290	0.92	2.8	1.0	0
Pine Bluffs, WY	1,117	0.56	1.43	0.22	0
Scottsbluff, NE	14,440	4.0	12.0	2.8	0
Torrington, WY	5,540	1.4[a]	3.5	0.35	0
Wheatland, WY	4,520	1.1[a]	2.8	2.0	0

Notes: 1 Groundwater suppliers are not required to provide treatment, except chlorination in some cases.

2 Maximum demands for one day in a recent year.

a Estimates based on 250 gpcd.

N/A - Data not available

Source: Local official interviews for water system data.

treated surface water. It has been reported by Banner Associates (1983) that "the estimated yield from the well system during a maximum monthly demand is about 9 mgd." For conservative estimation reasons, it has been assumed that 6 mgd is more nearly the long-term, sustainable production rate from the well system, at least for summer periods.

2.6.1.1.2 Water Distribution

2.6.1.1.2.1 General System

Water is delivered to the CBPU service population through pipelines ranging from 4 to 36 inches in diameter. The primary distribution network is shown in Figures 2.6.1-1 and 2.6.1-2 which also indicate the pipe diameters at critical segments. Also shown in Figure 2.6.1-2 is the third treated water storage facility in Cheyenne, the Buffalo Ridge tank, which has a capacity of 5 MG. The CBPU provides water to F.E. Warren AFB and the SCW&SD. These two entities are responsible for the water distribution systems within their respective service boundaries. The average-day water demand at F.E. Warren AFB is 1.0 mgd, and that at SCW&SD is about 0.7 mgd. The maximum-day demand at F.E. Warren AFB is 2.5 mgd, and SCW&SD's is 1.18 mgd.

Fees charged by the CBPU for new homes to tap into both water distribution pipes (with a three-quarter-inch service connection) and to sanitary sewers are $1,641. These fees include the actual tap-in plumbing costs, fees for any planning or engineering required, and administrative recordation costs.

The water rate for water delivered to residential customers is $1.09 per 1,000 gallons (expected to remain the rate until at least July 1984).

2.6.1.1.2.2 Water Distribution System Modeling

The computer model, WATSIM, was used to determine steady-state water pressures and storage-tank behavior in the nodal system shown in Figures 2.6.1-1 and 2.6.1-2 for the CBPU and in Figure 2.6.1-3 for the SCW&SD.

Numerous simulations have been made, and the results are reported here for specific neighborhoods and model nodes. The neighborhoods as defined for socioeconomic and land use purposes are shown in Figure 2.6.1-4, and the model nodes of interest in the five selected neighborhoods are shown in Figures 2.6.1-5 through 2.6.1-8.

The 1983 conditions of nodal demand and resulting pressure were simulated for a maximum-day demand taken as 2.3 x the average-day demand of 12.8 mgd, or 29.44 mgd, plus a firefighting flow of 4,860 gallons per minute (gpm) at the Frontier Mall shopping center in the southwestern portion of neighborhood 12. The resulting demand rates and pressures are given in Table 2.6.1-2. The resulting drain rate of the nearby Buffalo Ridge storage tank was determined by the model to be 221,250 gallons per hour (gph), a rate that could be sustained for over 11 hours if the tank were half full at the beginning of such a fire event. The analysis revealed that the residual pressure at the 2 fire hydrants would be 16 and 18 pounds per square inch (psi). A widely-held criterion for fire-flow residual pressure is 20 psi at a hydrant. The low pressure in this case appears to result from the presence of the singular, fairly long 8-inch main serving the more stressed of the two hydrants

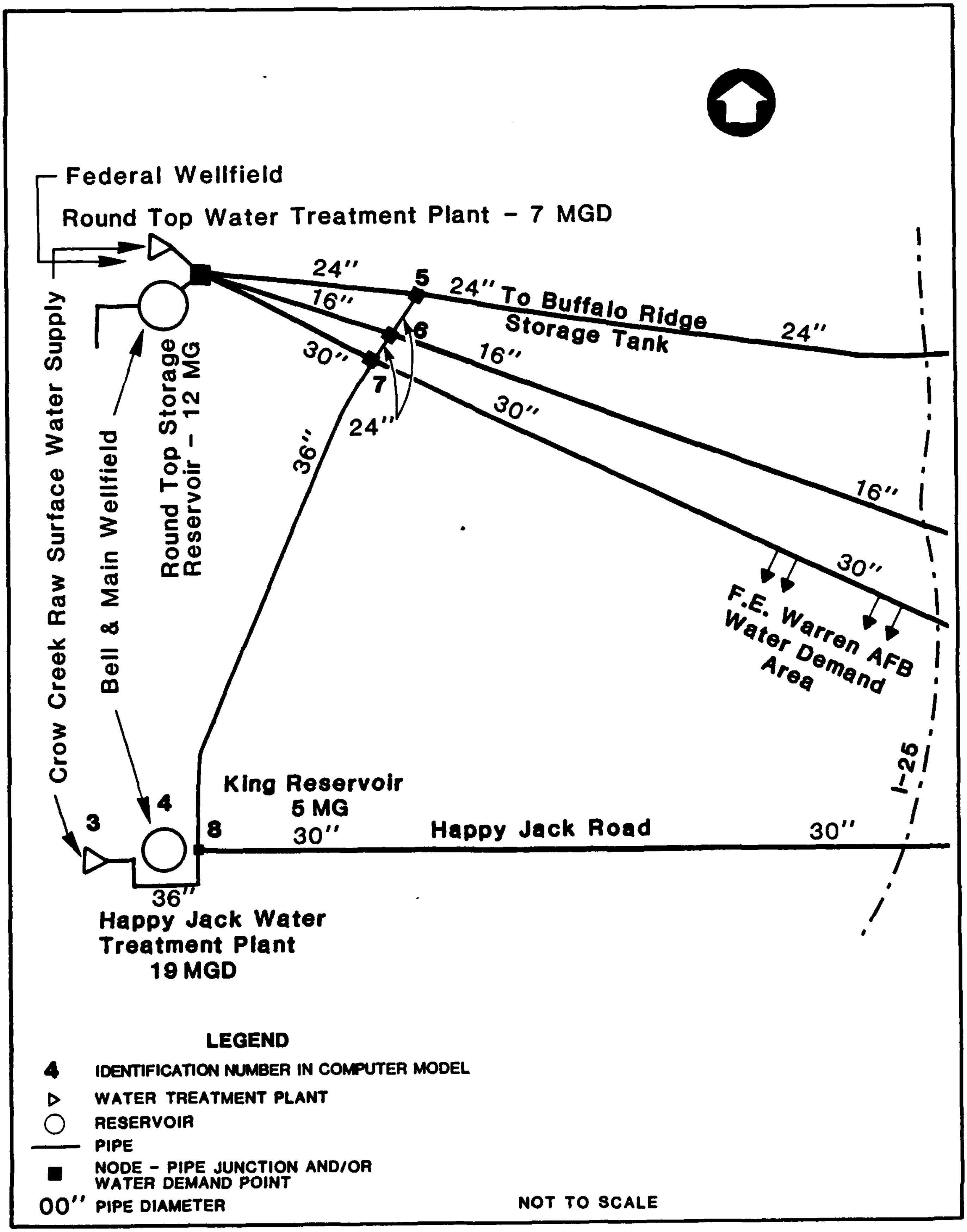


FIGURE 2.6.1-1 TREATMENT AND TRANSMISSION FACILITIES FOR CHEYENNE BOARD OF PUBLIC UTILITIES USED IN THE WATSIM MODEL

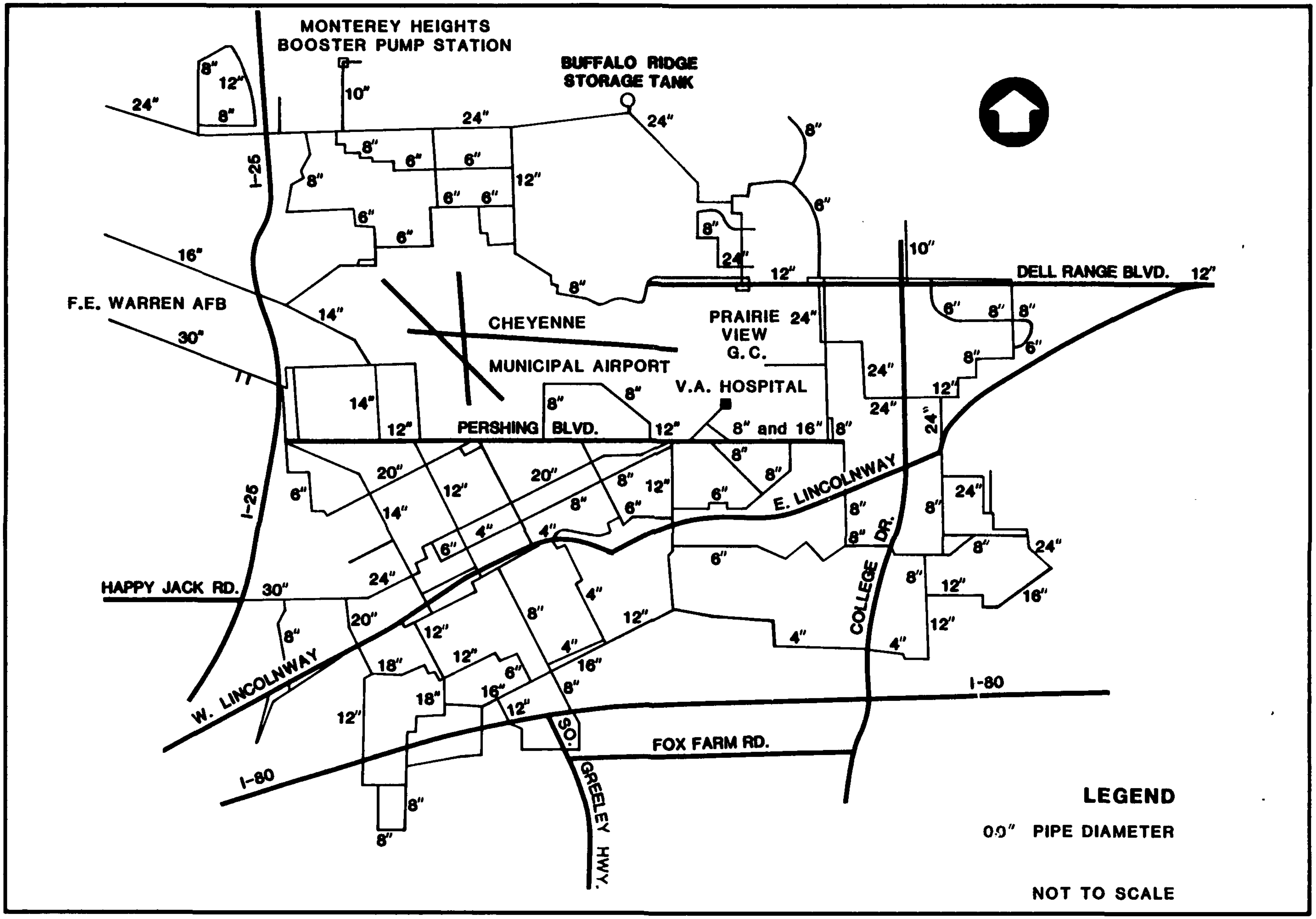


FIGURE 2.6.1-2 WATER DISTRIBUTION NETWORK FOR CHEYENNE BOARD OF PUBLIC UTILITIES USED IN THE WATSIM MODEL

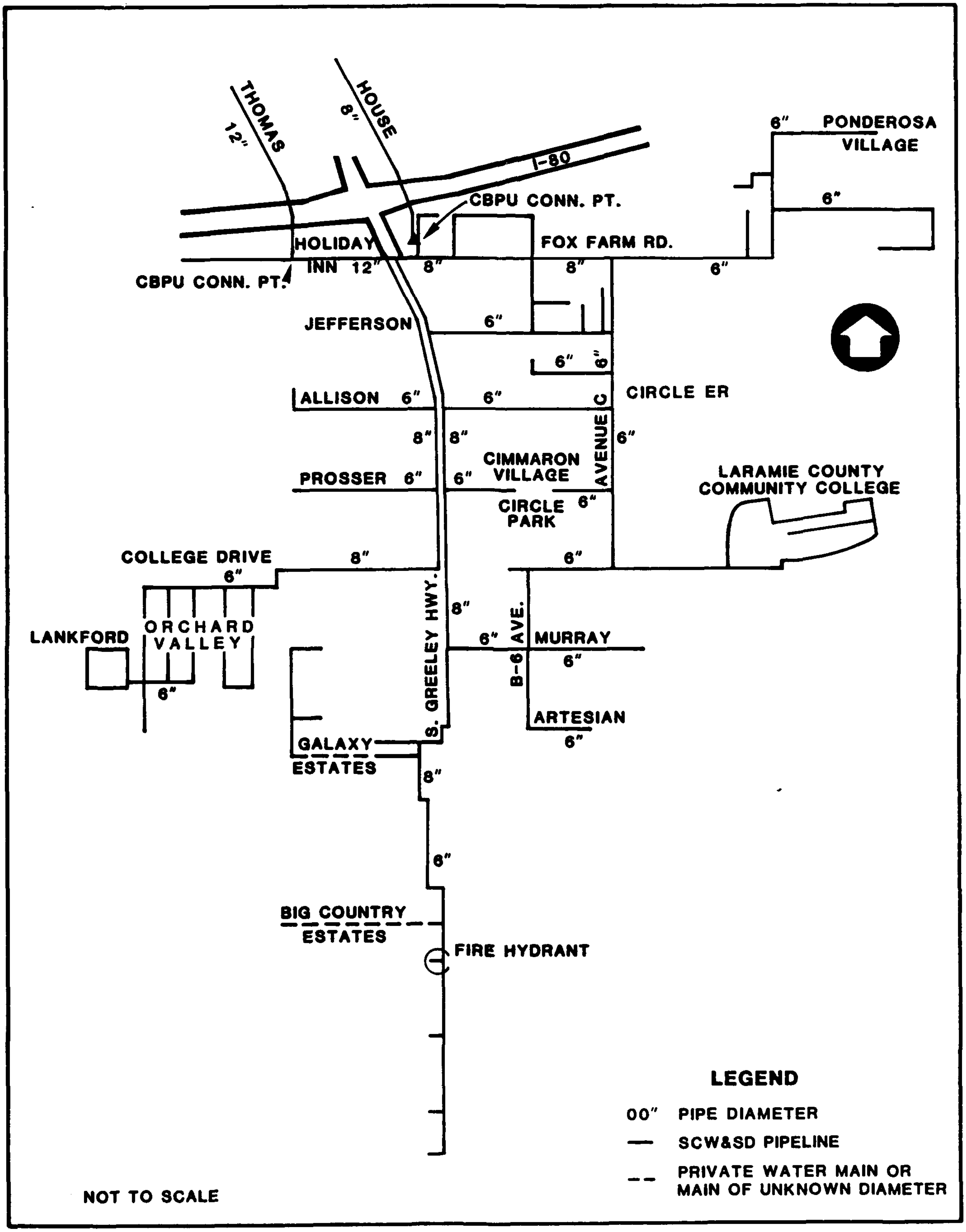


FIGURE 2.6.1-3 WATER DISTRIBUTION SYSTEM IN THE SOUTH CHEYENNE WATER AND SEWER DISTRICT

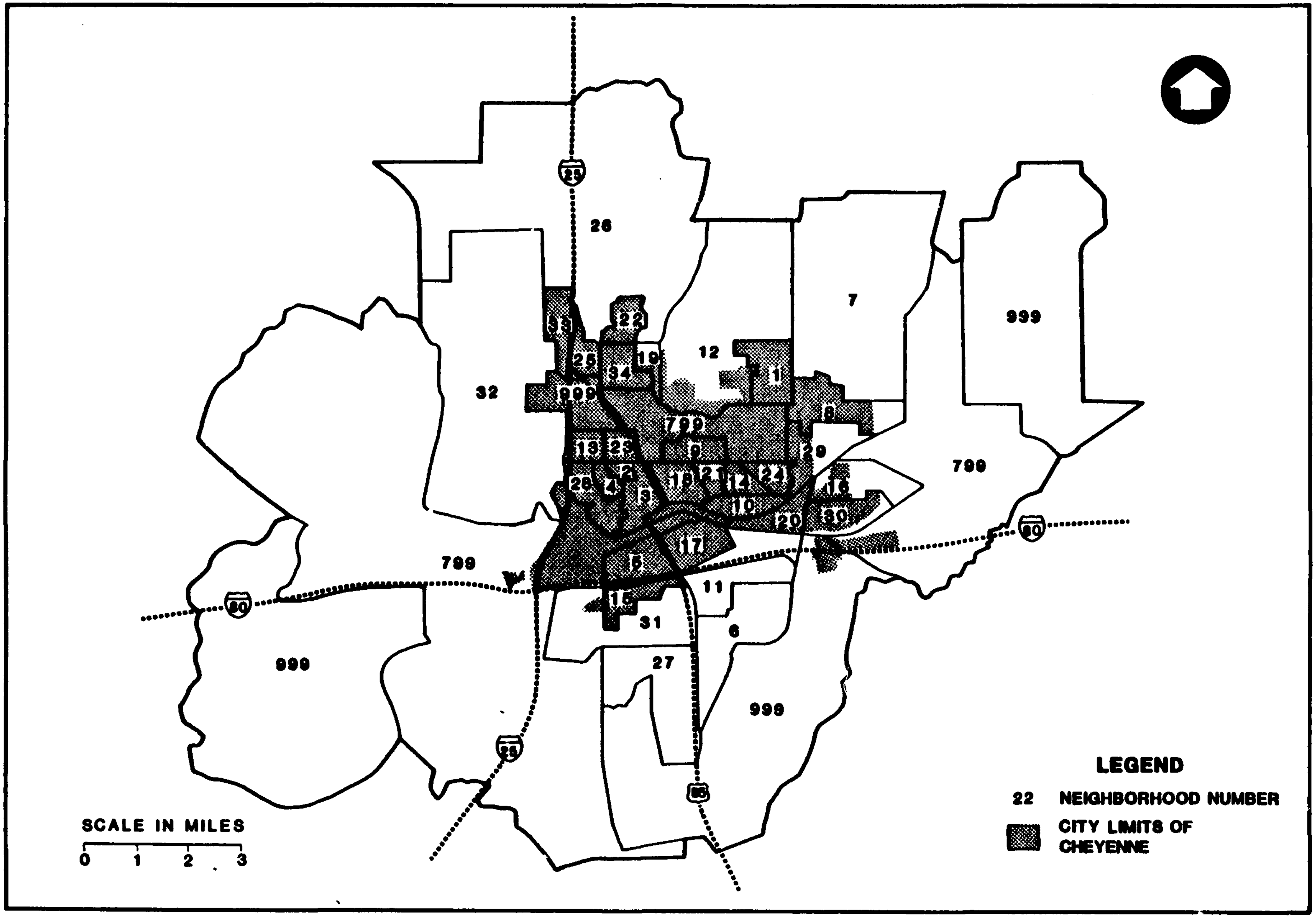


FIGURE 2.6.1-4 DESIGNATED NEIGHBORHOODS IN THE CHEYENNE REGION

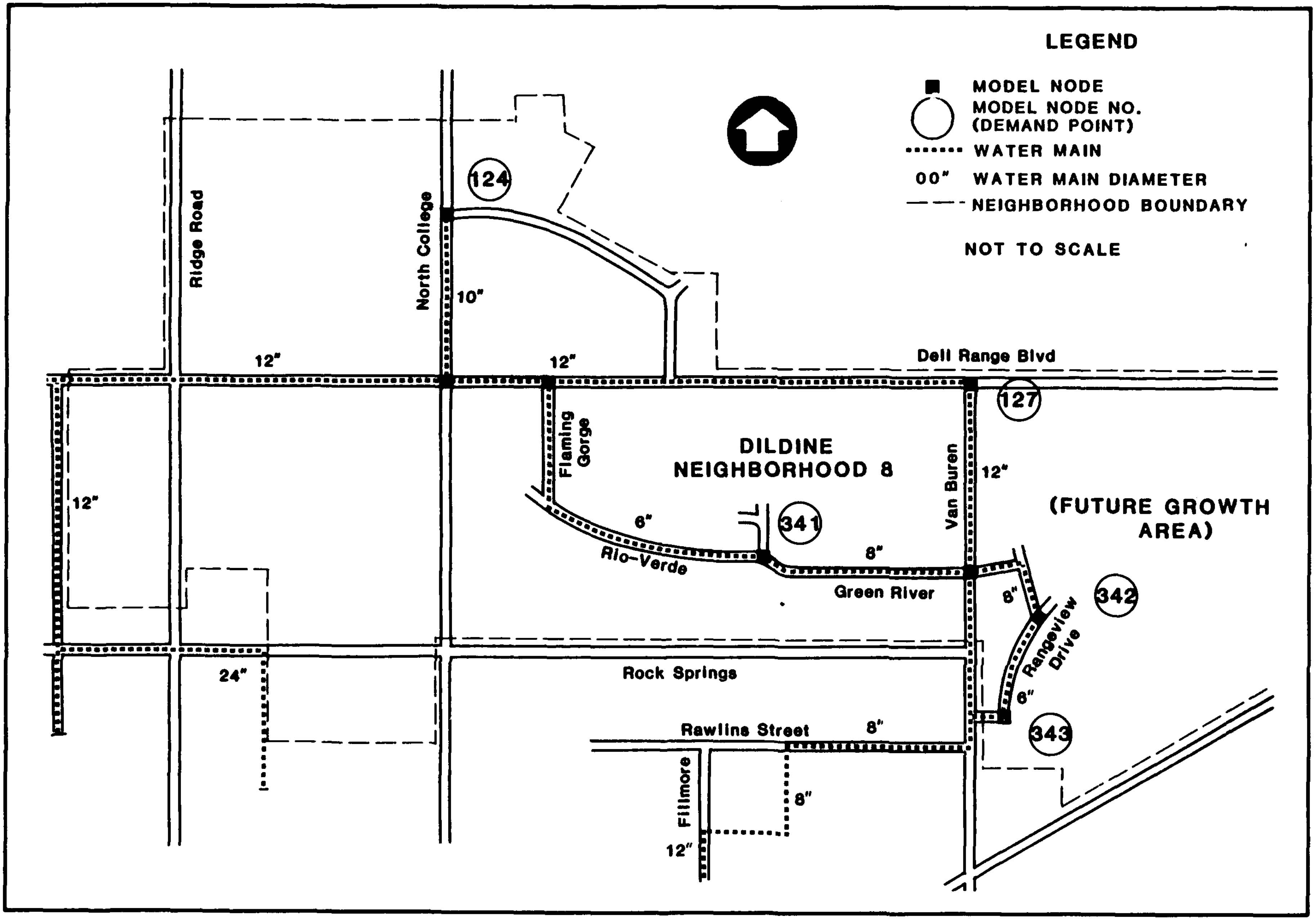


FIGURE 2.6.1-5 WATER MAINS AND MODEL NODES IN THE DILDINE NEIGHBORHOOD NO. 8

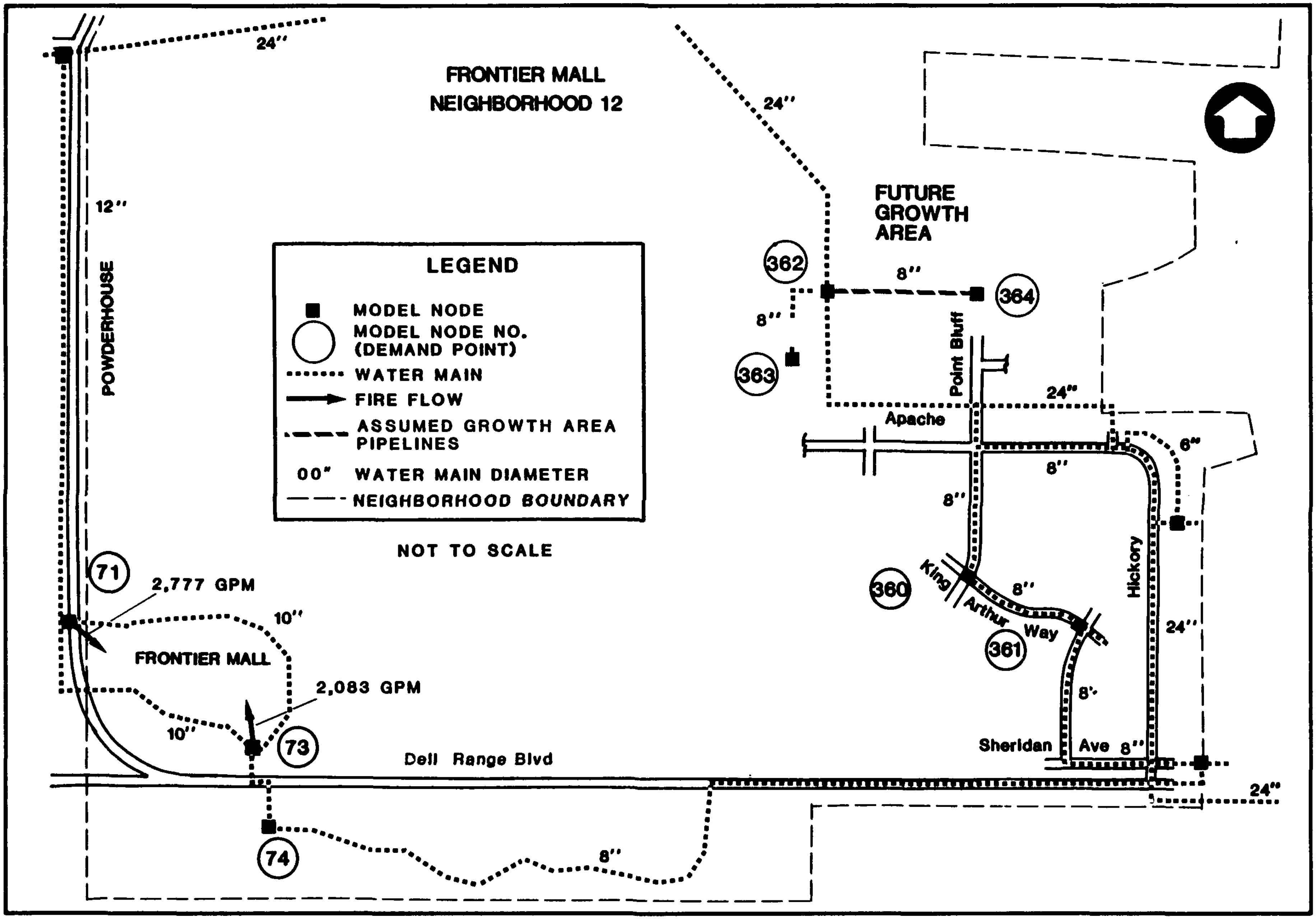


FIGURE 2.6.1-6 WATER MAINS AND MODEL NODES IN THE FRONTIER MALL NEIGHBORHOOD NO. 12

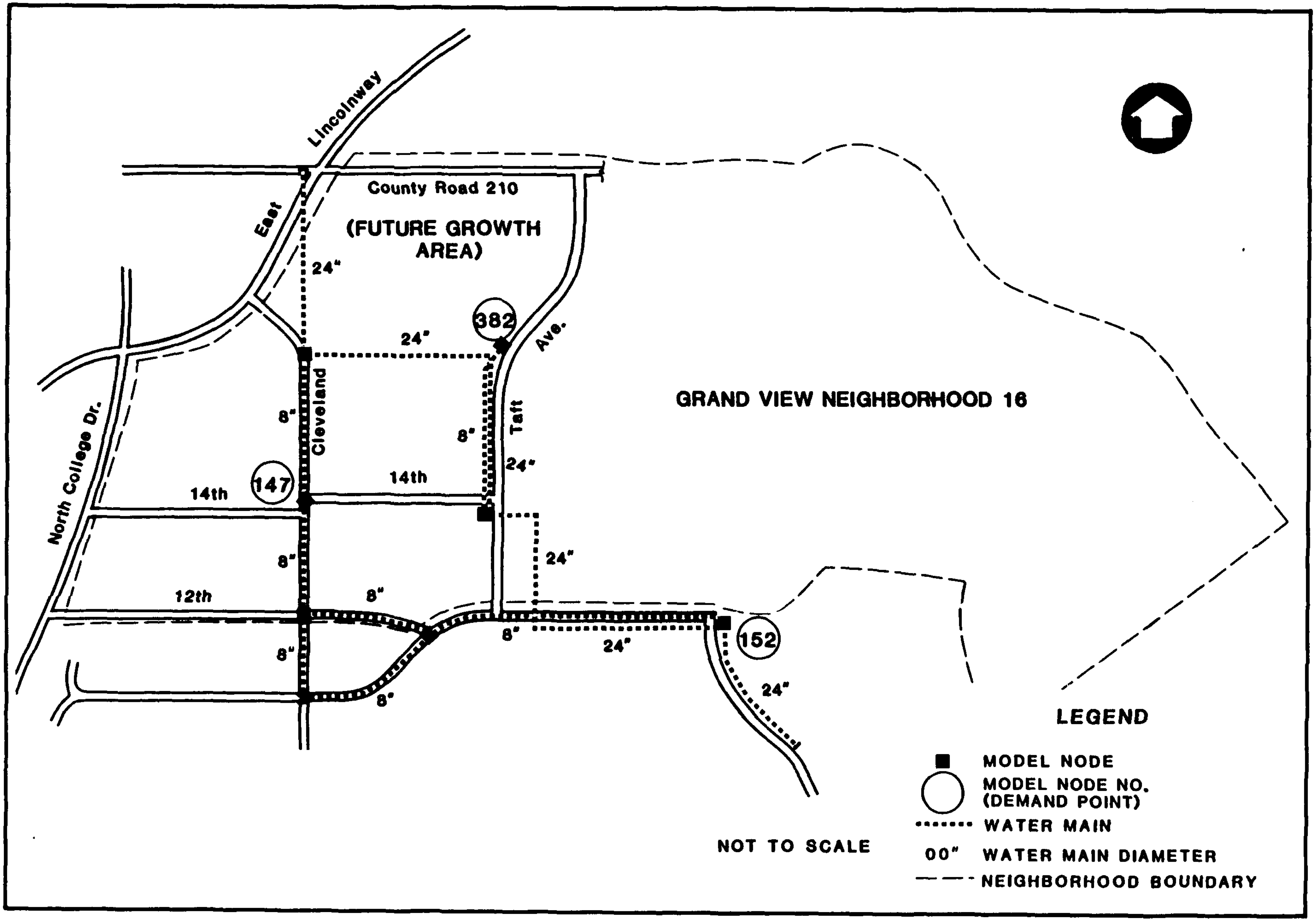


FIGURE 2.6.1-7 WATER MAINS AND MODEL NODES IN THE GRAND VIEW NEIGHBORHOOD NO. 16

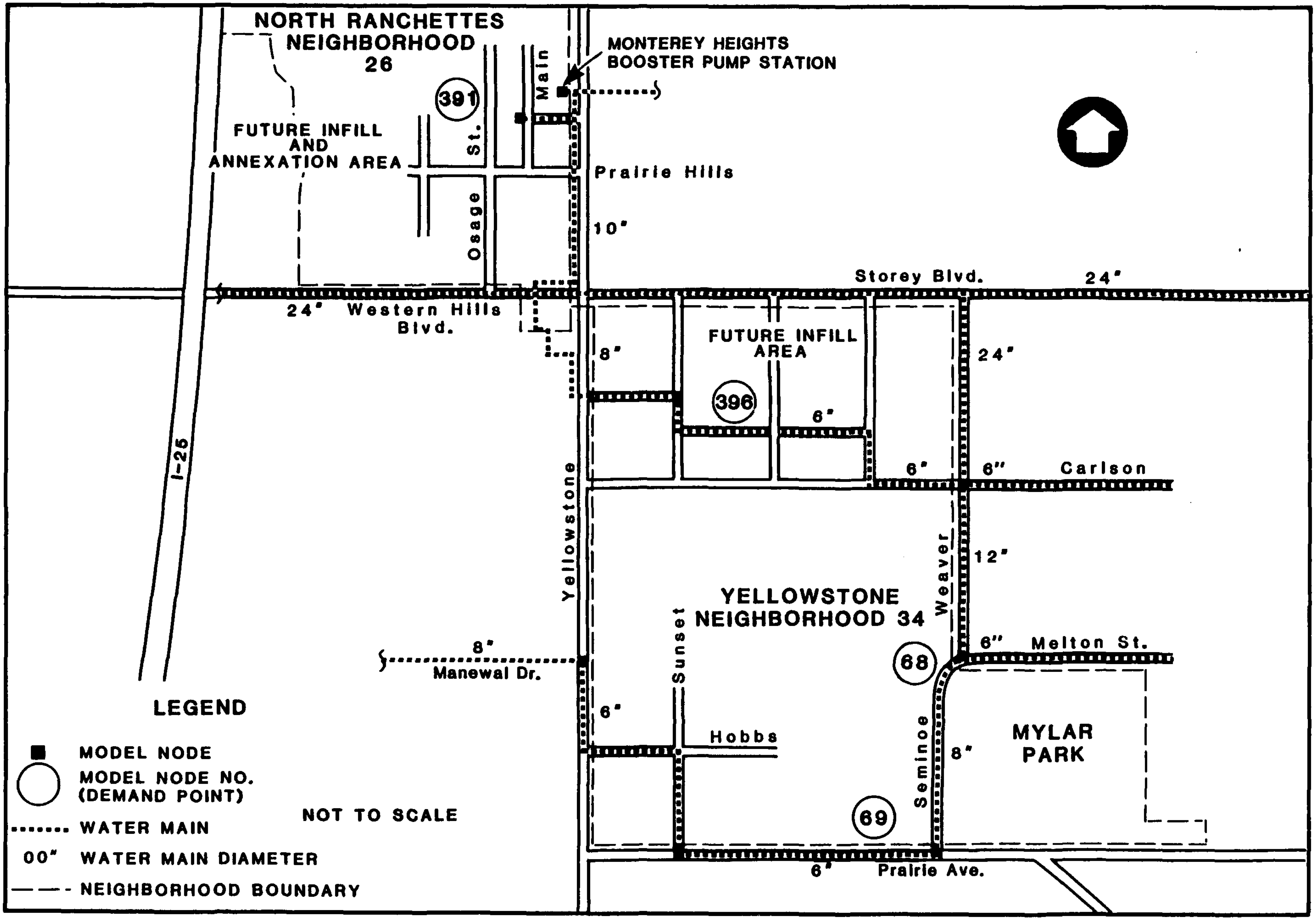


FIGURE 2.6.1-8 WATER MAINS AND MODEL NODES IN THE NORTH RANCHETTES AND YELLOWSTONE NEIGHBORHOODS NOS. 26 AND 34

Table 2.6.1-2

WATER DEMANDS AND PRESSURES AT SELECTED WATSIM NODES IN CHEYENNE NEIGHBORHOODS (1983 MAXIMUM DAY PLUS FIRE-FLOW EVENT)

Neighborhood[1]	WATSIM Node No.	Nodal Water Demand, mgd	Nodal Water Pressure, psi
Dildine	124	0.29	102
(8)	127	(Future-Demand Node)	
	341	0.62	129
	342	0.13	122.5
	343	0.13	127
Frontier Mall	360	0.43	104
(12)	361	0.43	107.5
	362	(Future-Demand Node)	
	71	4.0	18
	73	3.0	16
Grand View	147	0.68	120
(16)	382	(Future-Demand Node)	
North Ranchettes	391	(Future-Demand Node)	
(26)			
Yellowstone	396	0.09	81
(34)	69	0.21	78
	68	0.21	88

[1]Neighborhoods are shown by number in Figure 2.6.1-4

(node 73 Figure 2.6.1-6) being supplied from the east and south. It is likely that further in-filling development in this neighborhood will require installation of other water mains that will be interconnected with the 8-inch line. This will provide larger flows and alternate routes for flow to node 73, which will result in greater pressure there.

It should be noted that the WATSIM model was originally calibrated for the Cheyenne system with water pressure data collected at roughly 25 fire hydrants throughout the area by the Cheyenne Fire Department. Subsequently, the Board of Public Utilities supplied additional pressure measurements it had made or received from others for three other sites in various locations in town. Additional pipes and nodes were added to the model to represent the distribution system near these additional sites. The results were as follows. In the Monterey Heights neighborhood, the Board had measured a pressure of 54 psi at one of its booster pump stations. When that part of the system was added to the model, resulting simultated pressure in the WATSIM model was 59 psi. Pressure measured at the Board's own shop at 24th and Snyder streets ranged from 76 (for 1 hour) to 120 psi. The model showed 106 psi. Thirdly, a letter from the Veterans Administration hospital at 2360 Pershing Boulevard to the Board had complained of pressures on 4 evenings in the summer of 1983 as low as 25 psi. When the hospital's connection to the distribution system was added to the model and 4 cases of maximum-period demand were analyzed, the modeled pressures in the hospital ranged from 17 to 39 psi. The general calibration of the model at the outset of these analyses, coupled with these very specific verification exercises, provides convincing evidence that the model is functioning faithfully and can be usefully applied for discernment of baseline-growth and project-related impacts.

The water distribution system for the SCW&SD as shown in Figure 2.6.1-3 has also been modeled with the WATSIM computer program for 1983 conditions of maximum-day demand (1.18 mgd), plus a 450 gpm fire event at the fire hydrant on South Greeley Highway (U.S. 85), shown near the bottom of the figure. Water pressures to residential developments in the modeled grid ranged from 42 psi to 131 psi, as shown in Table 2.6.1-3. The pressure at the fire hydrant was modeled to be 28 psi, adequate but only 8 psi above the 20 psi standard-of-practice criterion for acceptable fire-flow pressure. It should be noted that both the SCW&SD and CBPU systems were modeled together as a single nodal network, which they are.

In October 1983 the District voted a moratorium into effect on any further tap-ins to its water and sewer lines, in large measure because it had received complaints about chronically low water pressures in portions of its existing distribution system. In November 1983 the sanitary engineering team making the analyses for this environmental impact statement (EIS) presented to the District's Board of Directors the results of detailed analyses it had made of a number of current conditions (and growth scenarios) with the WATSIM model. The model had corroborated, for example, that at the peak demand period of the day in 1983 with the highest recorded demand, it was possible to reach pressures in several parts of the system ranging from 0 to 20 psi. It was also demonstrated, however, that these problems were caused in large part by certain private developments being served by pipes smaller than 6 inches in diameter and in some part by the system's not being densely interlooped. Further development, it was explained, actually could improve the water pressure situation rather than worsen it, because additional water mains to

Table 2.6.1-3

WATER DEMANDS AND PRESSURES AT SELECTED
WATSIM NODES IN SOUTH CHEYENNE
1983 MAXIMUM-DAY PLUS FIRE-FLOW EVENT

Demand Point Description	WATSIM Node No.	Nodal Water Demand, mgd	Nodal Water Pressure, psi
CBPU Connection	116	1.38	80
CBPU Connection	118	.46	93
Ponderosa Village	696	.02	131
Continental	615	.01	109
Lankford	627	.01	88
Galaxy Estates	629	.07	75
Big Country Estates	661	.11	42
Fire Hydrant, U.S. 85	662	.65 (450 gpm)	28

support the new subdivisions or mobile-home parks would provide new, alternate routes and strengthening interconnections for the supplied water to travel. Study of Figure 2.6.1-3 will reveal that the current distribution system consists of two largely independent subsystems. Interconnection of the two, for example across South Greely Highway, would manifestly improve the stability of adequate pressures throughout the (then singular) network. Some interconnection, it was learned, had already been made beyond what is shown in Figure 2.6.1-3. Pressure improvements sought had been achieved.

2.6.1.2 All Other Communities

2.6.1.2.1 Chugwater, Wyoming

Chugwater supplies untreated groundwater to its residents through cast iron or black steel distribution pipes ranging from 2 to 6 inches in diameter. The water is supplied from 3 wells in town which have capacities of 60, 85, and 160 gpm (an equivalent total capacity of 0.439 mgd). During the fall and winter months only the 60 gpm pump is necessary, which means the normal, indoor, domestic usage rate for the 230 people in town is not greater than 375 gallons per capita per day. Until very recently water usage had not been metered. In the first few days of November 1983, the newly installed meter recorded daily use of 90,000 gallons, or 391 gpcd.

The water system has been in place since the 1930s. No expansions are currently planned. The water service fee charged by the town is $6.50 per month per customer. There are about 130 homes (customers). The tap-in charge for a new connection is $250.

2.6.1.2.2 Gering, Nebraska

The City owns and operates 9 active water supply wells whose total capacity is 9.0 mgd. There is one well that could be expanded or rehabilitated to add another 700 gpm of pumping capacity, equivalent to another 1.0 mgd. No treatment is provided.

The City has reported that for a recent service population of 7,760, the average delivery was 2.74 mgd at 354 gpcd. Peak flow has been 6.50 mgd, and peak flow plus firefighting flow has been 8.33 mgd. The existing (1983) population of Gering is 8,560. Given the recent per capita demand, the average daily demand for 8,560 people would be 3.03 mgd (8,560 x 354). The peak demand, computed from the ratio of the recent peak-to-average demands would be 7.19 mgd (3.03 x 6.50/2.74). Peak flow with a firefighting demand would be 9.02 mgd (7.19 + 8.33 - 6.50). All these demands computed from the 1983 population could be just met with the existing 9.0 mgd of capacity.

On a peak-day basis, excess capacity exists in the water system for 2,155 people: (9.0-7.19 mgd)/(354 x 6.50/2.74).

Water distribution piping in Gering ranges from 4 to 20-inch pipes which are maintained at 80 to 110 psi pressure. There are two storage tanks. One is an elevated 0.2 MG tank, and the other is a 1.0 MG ground level tank.

The staff for the Water Department is composed of three employees who operate both the water and wastewater systems. The 1983 budget for the water supply

operation is $265,000. Fees are charged for water used, but there is no tap-in fee for new connections. Water rates are $3.50 for the first 10,000 gallons used and $0.20/1,000 gallons thereafter. Monthly water use for a household averages 29,610 gallons (354 gpcd x 2.75 people/household x 365 days/12 mo). Therefore, an average monthly bill for a household is $27.42 ($3.50 + $0.20/1,000 gal x 19,610 gal). Average monthly revenue from water sales can be estimated as $22,880 (8,480/2.75 x $7.42/mo) or $274,600 per year.

2.6.1.2.3 Kimball, Nebraska

Kimball owns and operates 6 production wells ranging in depth from 120 to 370 feet. The two largest of these wells each produce 700 gpm, and the smallest produces 200 gpm. Total pumping capacity is 2,620 gpm according to a recent engineering report (Olsson Associates 1983). If all 6 wells were operated 24 hours per day they could produce 3.77 mgd to meet short-term peak demands. However, several of the wells pump air or sand when operated at capacity and therefore must be operated at a reduced rate. As a result, the City's peak capacity is approximately 3.15 mgd. On a long-term basis, the system's capacity is approximately 1.61 mgd.

The water is pumped into the distribution system (4 to 14-inch pipes and 1.0 MG of storage in a single tank) without treatment. Water pressures in town range from 60 to 70 pounds psi.

Current usage ranges from 150 to 400 gpcd and averages about 280 gpcd over the entire year. Customers include the city's residents and about 150 persons south of the city limits, for a total service population in 1983 of 3,290. Therefore, average usage today is about 0.92 mgd (3,290 x 280). Hence, excess capacity on a peak-day basis (assuming a peak-day to average-day ratio of 3:1) is 0.39 mgd (3.15 - 2.76). Also on a peak-day basis the excess capacity means that 464 additional persons could be served: (390,000 gal)/(280 x 3).

The water system in Kimball is operated by four employees. The 1983 budget is $225,000. Water rates for residential customers are a flat rate of $6.50 per month for the first 2,000 gallons, $0.60 per 1,000 gallons for the next 8,000 gallons, $0.46 per 1,000 for the next 20,000 gallons, $0.40 per 1,000 for the next 20,000 gallons, and $0.30 for each 1,000 gallons over 50,000.

The average household (customer) uses 23,400 gallons per month (280 gpcd x 2.75 x 365/12). The average bill, therefore, is $16.54 per month, based on the rate schedule quoted above. Yearly revenue from water sales to residential customers is about $236,700.

2.6.1.2.4 Pine Bluffs, Wyoming

Pine Bluffs obtains its water supply from five wells. The Town has a sixth well to be brought on-line in the near future. Neither chlorination nor any other treatment of the water is currently practiced. The average-day demand is 0.56 mgd with a peak-day demand of 1.43 mgd. The capacity of the wellfield is unknown but the Town recently acquired additional water rights.

The water distribution system contains 6 to 8 miles of line. The pipe diameters range from 4 to 8 inches. Pressures vary from 80 to 85 psi, and the general condition of the distribution system is described as good by the Town officials. Storage is provided by one 216,000-gallon tank.

2.6.1.2.5 Scottsbluff, Nebraska

Scottsbluff pumps all its potable water from wells. The distribution system consists of 4-inch to 24-inch pipelines with water pressures ranging from 40 to 85 psi.

The average-day water demand for this city of 14,440 is 4.0 mgd, or 277 gpcd. Peak-day demand is 3 times the average or 12.0 mgd. Peak-daily demand including firefighting demand is 14.0 mgd. The 2 mgd of firefighting demand represents less than the rate that could be supplied from available elevated storage over a day (2.65 MG). An additional 0.2 MG of storage is provided in an elevated tank at the nearby county airport.

The City's wells can supply water at 18.2 mgd (plus another 1.5 mgd capacity for the airport area). Consequently, for peak summer-day demands, the City could supply an additional 6.2 mgd (18.2 mgd-12.0 mgd). At the current peak usage rate of 12.0 mgd per 14,440 persons, this is equivalent to excess peak-day capacity for an additional 7,460 persons (6.2 mgd/831 gpcd).

The City operates its water supply system with the equivalent of 9.9 full-time employees. Its annual water supply budget is $659,045. Users are charged for water at the rate of $0.52 per 1,000 gallons. New homes are assessed a 1-time connection fee of $20.

2.6.1.2.6 Torrington, Wyoming

Torrington provides its public water supply from ten wells. No treatment is provided. Distribution piping ranges from 4 to 14-inch pipes. Two storage tanks exist. One is a 0.3 MG ground tank and the other is a 0.05 MG elevated storage tank. This amount of storage, 0.35 MG, is considerably less than the daily average demand of 1.39 mgd (5,540 people x 250 gpcd). A fire-flow adequacy study is underway now to identify needs for additional storage.

Fees for water service vary with the season. In the summer months charges are: 1) $4.00 for the first 30,000 gallons, 2) $0.16 per 1,000 gallons for deliveries between 30,000 and 75,000 gallons, and 3) $0.25 per 1,000 gallons for volumes above 75,000. In the winter months charges are: 1) $4.00 for the first 5,000 gallons, and 2) $0.25 per 1,000 gallons for all additional water.

The average household (customer) uses 20,910 gallons per month (250 gpcd x 2.75 x 365/12). In the summer months, therefore, the fees are the flat rate of $4.00. In the winter, the charge for water can be estimated to be $7.98 ($4.00, plus 15.9 x $0.25 = $3.98). The average rate, then, is about $6.00 per month: (4.00 + 7.98)/2. As a result, monthly revenue to the City from water sales is about be $12,360 (5,665/2.75 x $6.00), or $148,300 annually.

2.6.1.2.7 Wheatland, Wyoming

The Town of Wheatland obtains its water supply from a wellfield. The Town has eight wells but only pumps five at any time, rotating among the eight available. During peak demand times, in the summer, the five wells are pumped for longer periods than during the lower-demand winter months. The pumping rate averages 450 gpm (0.648 mgd) for each well. The peak demand is greater than 2 mgd. According to Town officials, water from the wells is pumped into settling basins for chlorination. Treated water storage consists of 2 elevated tanks, each with a capacity of 1 MG.

The water transmission lines are 6 and 8 inches in diameter. The distribution pipes range from 2 to 12 inches. Wheatland is currently replacing some of the 2-inch lines.

Water fees for residential customers are $3.50 per month for the first 5,000 gallons and $0.25 per 1,000 gallons in excess of the first 5,000 gallons.

2.6.2 Wastewater

2.6.2.1 Cheyenne Urban Area

The CBPU provides sewers and operates two waste treatment plants in the city of Cheyenne. The SCW&SD collects sewage and operates a third plant in South Cheyenne. Analyses of the capacities of the sewer systems and the plants have been performed and are discussed separately below.

Fees for new homes in Cheyenne to connect to water distribution pipes (with a three-quarter-inch service connection) and to sanitary sewers are $1,641. These fees include the actual tap-in plumbing costs, fees for any planning or engineering required, and administrative costs. The rate for sanitary sewage is $0.51 per 1,000 gallons, the flow being computed from metered water usage.

2.6.2.1.1 Sanitary Sewers

The 3 sewage drainage basins in the region are Crow Creek (average generated flow = 4.61 mgd) and Dry Creek (average generated flow = 3.30 mgd) in Cheyenne, and the South Cheyenne basin (average generated flow = 0.67 mgd) located in the SCW&SD. F.E. Warren AFB contributes its flow (0.6 mgd) to the Crow Creek system.

For this analysis, each of the three sewer systems was represented as a network of its major pipes, and the hydraulic behavior of sewage flow was simulated with SWMM. As-built construction drawings were consulted for much of the information, and field surveying was necessary to check some values. Nonetheless, the networks should be viewed as approximations to the actual conditions, since resolution of all problems with 3 different elevation datums and the infeasibility of representing all the smaller sewers could not be overcome. But despite being approximations, the simulations corroborated behavior at several points known to cause problems today and were more than adequate for planning purposes.

The modeled networks for Cheyenne and South Cheyenne are shown in Figures 2.6.2-1 and 2.6.2-2, respectively.

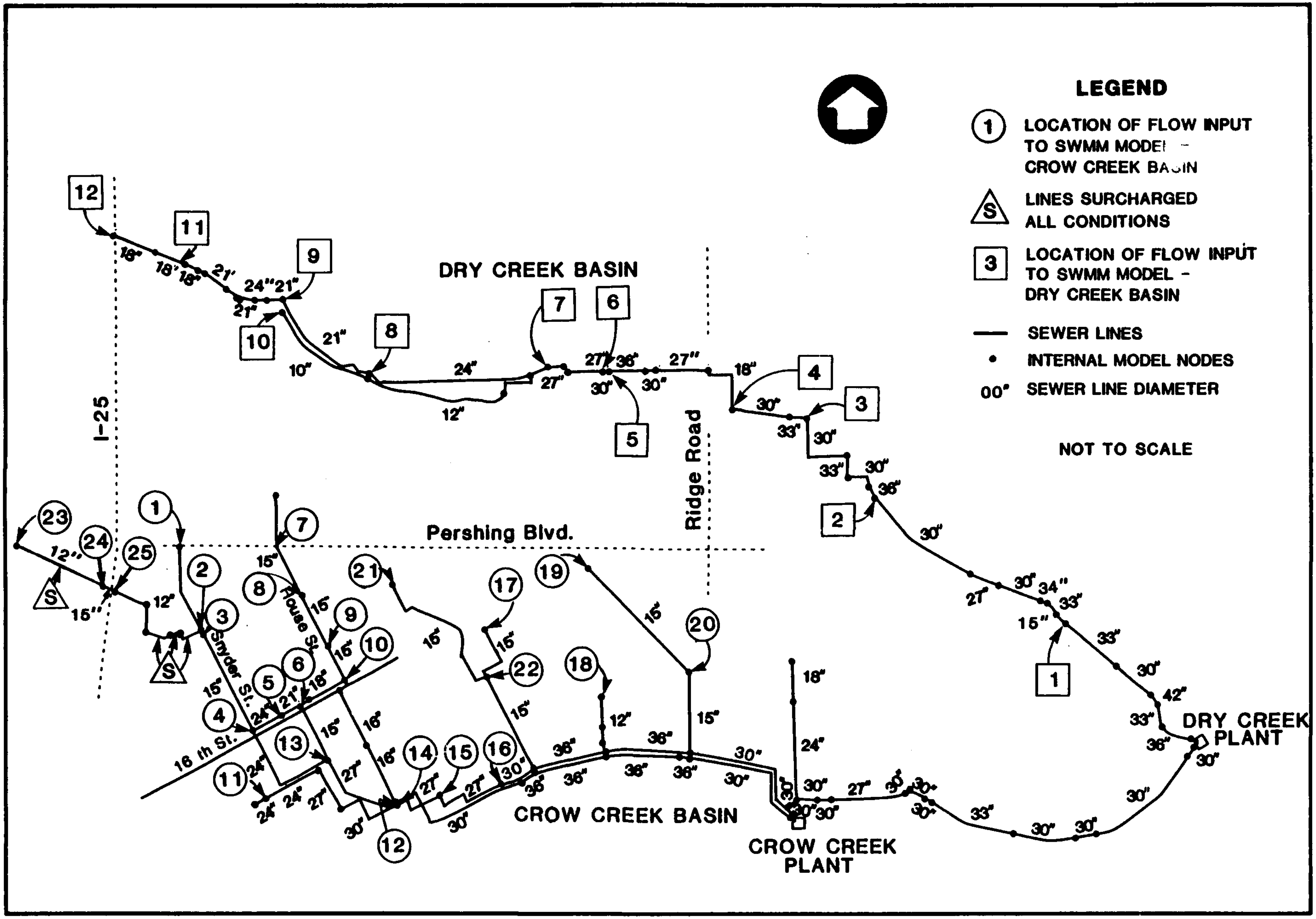


FIGURE 2.6.2-1 SWMM MODEL NETWORKS FOR CHEYENNE SANITARY SEWERS

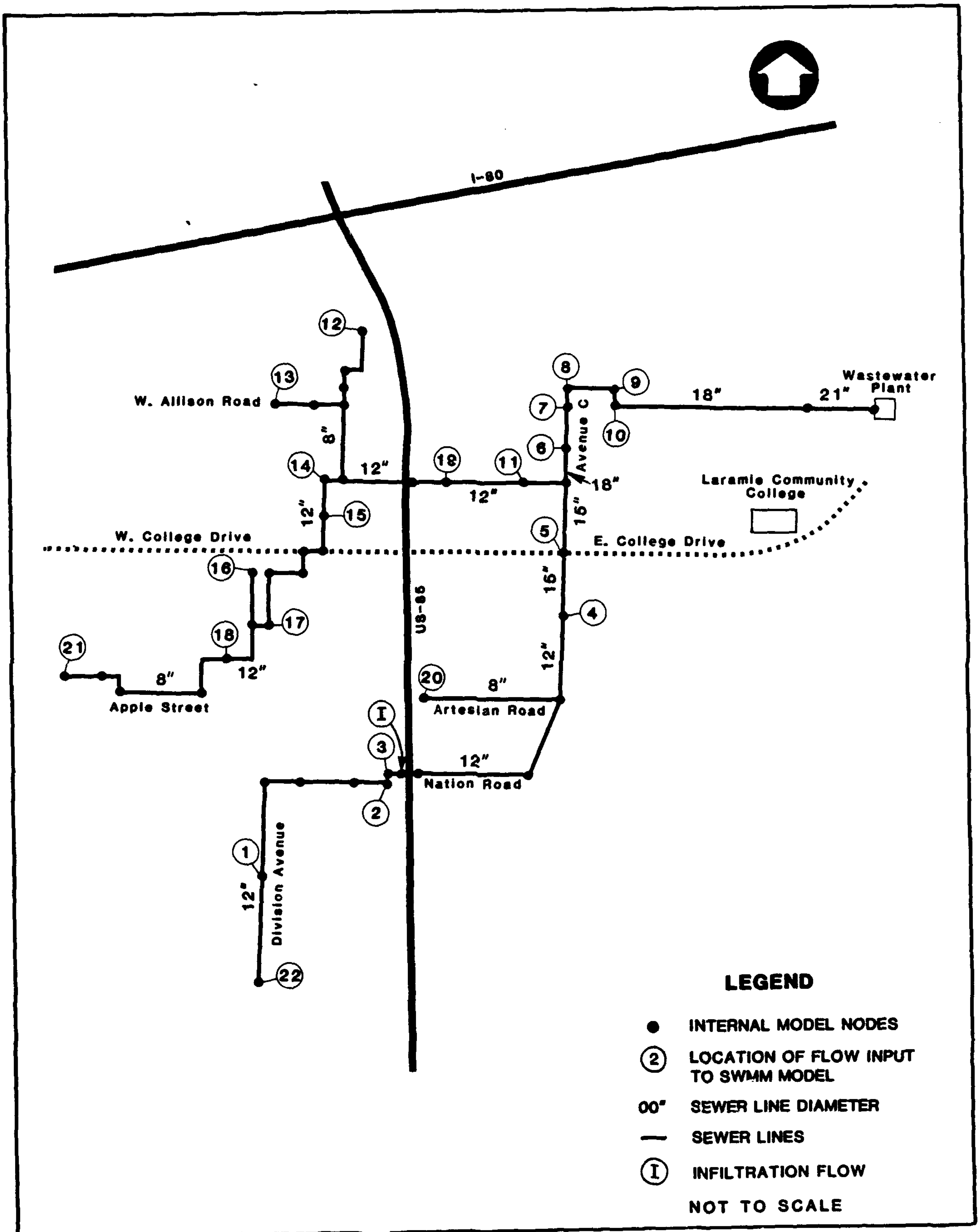


FIGURE 2.6.2-2 SWMM MODEL NETWORK FOR SOUTH CHEYENNE SANITARY SEWERS

Sewage flows were added as 24-hour hydrographs to the modeled networks at the indicated input points. The individual values were computed from projected 1983 populations and distributed throughout each basin in proportion to the 1980 populations in census tracts adjacent to the indicated nodes. Per capita waste generation rates of 150 gpcd for the Crow Creek and Dry Creek basins and 107 gpcd for the SCW&SD were used. The populations assigned to each hydrograph input point are given in Table 2.6.2-1.

The major sewers simulated for all three basins are able to contain the 1983 flows, with one exception. Some 12-inch pipelines in the Crow Creek basin, just downstream from the 12 and 15-inch pipelines leaving F.E. Warren AFB, become surcharged (i.e., exceed capacity and overflow to streets and basements).

Surcharging is known to occur at or near that junction periodically. The model contains the optional, useful ability to increase the size of a surcharged pipe until the surcharge condition no longer exists. In this case, the model increased the simulated downstream 12-inch pipe segments which surcharged to a 15-inch pipe, and the surcharge problem ceased to exist.

2.6.2.1.2 Treatment Plants

In 1982 a Facilities Plan was drafted for Laramie County, the CBPU, and the SCW&SD, which described detailed plans for upgrading waste treatment capacity for the entire Cheyenne Urban Area (Banner Associates 1982). This plan was eventually submitted for approval and funding, pursuant to Section 201 of Public Law 92-500 as amended, to the State of Wyoming and the U.S. Environmental Protection Agency (EPA). Features of the plan included abandonment of the South Cheyenne plant, transport of South Cheyenne's wastewater to the Crow Creek plant, diversion of flows in excess of 4.0 mgd from the Crow Creek plant to the Dry Creek plant, expansion of the Dry Creek plant to 7.0 mgd, and specific improvements to both the Crow Creek and Dry Creek plants. Early funding would allow needed improvements, described below, to be implemented immediately.

The Dry Creek plant, a relatively new facility constructed in 1974, has a projected lifetime beyond the year 2000. It is a conventional activated sludge plant with a design capacity of 4.5 mgd. Present hydraulic loading on the facility is 3.6 mgd.

The design and performance characteristics of the Dry Creek plant, shown in Table 2.6.2-2, are well within acceptable limits for a 4.5 mgd plant, the only exception being an overloading of the primary clarifier during peak flows. The 201 Facilities Plan prepared by Banner Associates (1982) reports that with improvements, such as minor rerouting of scum and grease removal pipelines in the primary and final clarifiers, replacement of minor items of defective equipment, and implementation of improved operational and maintenance procedures, the Dry Creek plant should have no difficulty in producing an effluent of required quality with an average flow of 4.5 mgd.

The Crow Creek plant uses a high-rate trickling filter treatment process. The plant was constructed in the mid-1940s and was upgraded in 1974. Effluent quality meets the plant's National Pollutant Discharge Elimination System (NPDES) permit requirements for secondary treatment and disinfection. The

Table 2.6.2-1

BASELINE POPULATIONS ALLOCATED TO SEWER SYSTEM MODEL NODES

Crow Creek Basin		Dry Creek Basin		South Cheyenne Basin	
Model Node No.[1]	1983 Population	Model Node No.[1]	1983 Population	Model Node No.[2]	1983 Population
1	1,695	1	1,024	1	690
2	698	2	905	2	270
3	685	3	3,242	3	859
4	2,025	4	708	4	88
5	569	5	1,735	5	36
6	1,122	6	958	6	31
7	1,783	7	1,635	7	58
8	386	8	423	8	470
9	633	9	3,569	9	442
10	1,588	10	540	10	117
11	2,232	11	513	11	648
12	1,187	12	2,529	12	300
13	929	13	4,077[b]	13	65
14	513			14	152
15	794			15	291
16	794			16	37
17	2,478			17	65
18	650			18	1,483
19	1,886			19	0
20	2,814			20	48
21	1,541			21	0
22	101			22	0
23	3,000[a]				
24	1,500[a]				
25	1,500[a]				

Notes:
1 Model node numbers are shown in Figure 2.6.2-1.
2 Model node numbers are shown in Figure 2.6.2-2.
a F.E. Warren AFB population was modeled as 6,000 to simulate infiltration into AFB sewers. Actual AFB population is 3,630.
b This population is assigned to a sub-basin tributary to the Crow Creek-Dry Creek diversion sewer. The diversion sewer has a capacity of 10 mgd at the critical section and was not modeled.

Table 2.6.2-2

DESIGN AND PERFORMANCE CHARACTERISTICS
FOR THE DRY CREEK TREATMENT PLANT

Plant Unit	Existing Characteristics	Desirable Design Characteristics for 4.5 mgd
PRIMARY CLARIFICATION		
Surface Overflow Rate (gal/day/ft^2)	800	1,000 or less[a]
Peak Overflow Rate (gal/day/ft^2)	1,800	1,500 or less[a]
Sidewater Depth, ft	10	7 or more[a]
Weir Overflow Rate (gal/day/foot)	11,700	15,000 or less[a]
ACTIVATED SLUDGE AERATION		
Organic Loading (lb BOD/day/1,000 ft^3)	34	40 or less[a]
Depth (ft)	13	10 to 40[a]
Volume (MG)	0.965	0.932[b]
SECONDARY CLARIFICATION		
Sidewater Depth (ft)	12	12[a]
Solids Loading Rate (lb/ft^2/day)	12.6[c]	50 or less[a]
Surface Overflow Rate (gal/day/ft^2)	585	800 or less[b]
Peak Overflow Rate (gal/day/ft^2)	1,300	1,600 or less[b]
Weir Overflow Rate (gal/day/foot)	10,000	10,000 or less[a]
EFFLUENT QUALITY		
BOD_5, mg/l	27[e]	30[d]
Suspended Solids, mg/l	27[e]	30[d]

Sources:
- a Ten-State Standards for Sewage Works.
- b Wastewater Treatment Plant Design, ASCE-WPCF Manual of Practice.
- c CAPDET model result.
- d Wyoming NPDES requirement.
- e Average monthly effluent measurement, 1982.

flow to the plant has been recorded in recent months at an average value of 3.8 mgd. However, a very recent investigation by the Board of Public Utilities has revealed that the flow has actually been underestimated through a systematic measurement error by some amount which the Board is still determining. Comparison of recent and prior-year records has indicated to analysts performing this study that the error is probably about half a million gallons per day.

That value has been added to the previously incorrectly "measured" 3.8 mgd at the Crow Creek and to the 3.51 mgd previously correctly measured at the Dry Creek plant for a total of 7.81 mgd for the Board's service area. This flow was divided by the population contributing to both plants in 1983, and a nominal 150 gpcd value has resulted (7,810,000 gallons per day ÷ 52,704 people = 148.2 gpcd). It is fair to note that the measurement error had been estimated by a commentor on the draft issue of this report to be as high as 1.0 mgd, not 0.5 mgd. The most that can be said at this juncture is: the magnitude of the error is not known; it is being investigated; and this study has put its best estimate, based on admittedly sketchy data, at 0.5 mgd. Unquestionably the absolute amount of the error has implications for the 201 Plan. Most directly stated, it means that the expansion of the Dry Creek plant, now planned for 4.5 to 7.0 mgd, should be larger. The Board of Public Utilities and all concerned now intend to alter the 201 Plan as required in this regard during the design stage of Plan implementation, by which time the amount of the measurement error will have been resolved.

The design capacity of the Crow Creek plant is 4.0 mgd, but its performance has also been satisfactory at higher flows up to 5.5 mgd which it occasionally receives. It should be noted that the inflow to the plant is now averaging 4.3 mgd, although flow generated in the Crow Creek basin already averages 4.61 mgd. The extra 0.31 mgd is diverted for treatment at the Dry Creek plant.

The 201 Facilities Plan (Banner Associates 1982) recommends several corrective measures to ensure the continued effectiveness of this plant. These include incorporation of a flow control device for the grit chamber, replacement of aging structural steel, ventilation of filters, addition of chemical-feed equipment, and renovation of the sludge digester.

An analysis of the design and performance of the treatment plant is presented in Table 2.6.2-3. It indicates that the current characteristics and design performance of the plant are well within the accepted standards of practice for the design flow of 4 mgd.

The South Cheyenne plant is an extended aeration treatment plant, currently serving a population of about 6,250. The plant was originally built about 1950 and has been expanded over the years to its present capacity. Average monthly flow for January through May 1983 ranged from 0.66 mgd to 1.28 mgd, with peak daily flows as high as 1.42 mgd. The facility is clearly not able to treat these quantities of wastewater adequately. The average effluent biochemical oxygen demand (BOD) and suspended solids concentrations for the January to May period were 58 milligrams per liter (mg/l) and 73 mg/l, respectively. The facility was designed for 0.8 mgd, but a number of design deficiencies limit the plant's capacity and prevent it from producing a satisfactory effluent at this flow.

Table 2.6.2-3

DESIGN AND PERFORMANCE CHARACTERISTICS
FOR THE CROW CREEK TREATMENT PLANT

Plant Unit	Existing Characteristics	Desirable Design Characteristics for 4.0 mgd
PRIMARY CLARIFICATION		
Surface Overflow Rate ($gal/day/ft^2$)	398	1,000 or less[a]
Peak Overflow Rate ($gal/day/ft^2$)	896	1,500 or less[a]
Sidewater Depth (ft)	10.5	7 or more[a]
Weir Overflow Rate (gal/day/foot)	8,000	15,000 or less[a]
TRICKLING FILTER (High Rate)		
Organic Loading (lb/acre-ft/day)	1,260	1,000-13,000[b]
Depth (ft)	5	3 to 8[b]
Recirculation Ratio	1.5:1	0.5-4:1
Hydraulic Loading ($gal/day/ft^2$)	140	230-900[b]
SECONDARY CLARIFICATION		
Surface Overflow Rate ($gal/day/ft^2$)	400	800 or less[b]
Peak Overflow Rate ($gal/day/ft^2$)	900	1,200 or less[a]
Sidewater Depth (ft)	10.5	7 or more[a]
Weir Overflow Rate (gal/day/foot)	4,494	15,000 or less[a]
EFFLUENT QUALITY		
BOD_5, mg/l	27[c]	30[d]
Suspended Solids, mg/l	27[c]	30[d]

Sources:
- a Ten-State Standards for Sewage Works.
- b Wastewater Treatment Plant Design, ASCE-WPCF Manual of Practice, p. 285.
- c 1982 yearly average effluent measurement.
- d Wyoming NPDES requirement.

The design and performance characteristics of the South Cheyenne plant are listed in Table 2.6.2-4. Performance characteristics are based on the design flow of 0.8 mgd and influent characteristics of 210 mg/l of BOD and 266 mg/l of suspended solids. These concentrations are monthly averages for April 1983. In that month, the average daily flow was 0.81 mgd.

The table indicates a number of serious design deficiencies including insufficient detention time, a shallow secondary clarifier, and weir overflow rates exceeding design standards by 67 percent. The 201 Facilities Plan (Banner Associates 1982) points out additional shortcomings including pretreatment inadequacies, poorly functioning skimming and sludge withdrawal systems, deteriorated chlorination equipment, and general shortcomings in operation. It was also recognized that further expenditures to improve this facility may not be cost-effective. Consequently, the Plan's recommendations were to abandon this facility and to bypass all wastewater flows to either the Crow Creek or Dry Creek plants. Diversion to the Crow Creek facility, with further diversion to Dry Creek of flows in excess of 4 mgd, is the most current plan (Banner Associates 1982) and has been assumed here.

2.6.2.2 All Other Communities

2.6.2.2.1 Chugwater, Wyoming

Chugwater discharges its sanitary wastewater into two 1-acre evaporative lagoons. There is no aeration or other treatment given. Current flows to the lagoon are not measured, but at 100 gpcd they can be estimated to be 0.023 mgd. Evaporation, however, can account for only about one-quarter of the outflow, and the balance is believed to be seeping into the ground. The capacity for seepage is not known, so excess capacity cannot be estimated; however, the existing lagoon has filled to capacity only on rare occasions.

2.6.2.2.2 Gering, Nebraska

Gering has a 1.93 mgd multiple-cell lagoon system for waste treatment. The average flow to the lagoons has been reported to be 1.35 mgd. Of this amount 1.02 mgd is domestic waste and 0.331 mgd is industrial. The unit load for domestic waste has been computed to be 119 gpcd (1.02 mgd/8,560 persons). On an average-day basis, the plant has excess capacity for an additional 4,874 persons; but on a peak-day basis, this plant, though recently expanded and upgraded, is already at capacity.

2.6.2.2.3 Kimball, Nebraska

Kimball operates a 2-year old extended aeration plant designed for 0.576 mgd and 7,240 people (80 gpcd). The plant now serves the city's population plus 150 people in outlying areas, a total of 3,290 people.

Records indicate that the plant now receives between 0.284 mgd and 0.410 mgd on an average day, which suggest that current unit flow rates are between 87 and 125 gpcd. If an in-between, nominal value of 100 gpcd were assumed for both current and future unit flows, the plant could serve 5,760 people. This means there is excess capacity for 2,470 additional people.

Table 2.6.2-4

DESIGN AND PERFORMANCE CHARACTERISTICS
FOR THE SOUTH CHEYENNE TREATMENT PLANT

Plant Unit	Existing Characteristics	Desirable Design Characteristics for 0.8 mgd
AERATION BASIN		
Volume, MG	0.805	0.866[c]
O_2 Transfer Efficiency (lb O_2/HP-hr)	3.4	1.8 or more[a]
Organic Loading (lb BOD/day/1,000 ft^3)	13.3	15 or less[a]
Detention Time, hr	24	26[c]
SECONDARY CLARIFICATION		
Solids Loading Rate (lb/ft^2/day)	10[c]	50 or less[a]
Surface Overflow Rate (gal/day/ft^2)	347	800 or less[b]
Peak Overflow Rate (gal/day/ft^2)	781	1,600 or less[b]
Weir Overflow Rate (gal/day/foot)	16,700	10,000 or less[a]
Sidewater Depth, ft	7.5	12[a]
EFFLUENT QUALITY		
BOD_5, mg/l	52[d]	30[e]
Suspended Solids, mg/l	54[d]	30[e]

Sources:
- a Ten-State Standards for Sewage Works.
- b Wastewater Treatment Plant Design, ASCE-WPCF Manual of Practice.
- c CAPDET model result.
- d Average concentration of effluent for April 1983.
- e Wyoming NPDES requirement.

The plant, which discharges to Lodgepole Creek north of the city, receives its flow through a 12-inch intercepting sewer from the city. Many other smaller sewers are connected to the interceptor. The major portion of the City sewer system is clay pipe. Although 70 percent of the system was laid 60 to 70 years ago, it remains in "fair" condition, according to the City Administrator.

A $10 tap-in is charged for new connections. Current customers are charged a flat monthly service charge of $3.39 per household plus $0.34 per 1,000 gallons. (It can be assumed that the sewage flows are not metered and that this charge is computed as part of the water delivery charge, a fairly standard practice, since the water supplied to each house is metered.) Thus, the average monthly charge to the 1,196 homes (3,290/2.75) is $3.48 ($3.39, plus 275 gal/home x $0.34 per 1,000 gal = $3.39 + $0.09). The annual revenue to the City for waste collection and treatment is $49,945 ($3.48/mo.-home x 1,196 homes x 12 mo/year).

2.6.2.2.4 Pine Bluffs, Wyoming

Pine Bluffs treats its sewage in a two-cell lagoon system. The lagoons total approximately 3 to 3.5 acres in area. Aeration is not used. The present sewage flow averages 0.1 mgd but the system is designed for 0.09 mgd. Because the system is currently operating over its design capacity, the Town has applied for a grant to add 10 additional acres to the lagoon system. Design is underway for the expanded lagoon system, which will serve a total of 1,600 people.

The sanitary sewers range from 8 to 12 inches in diameter. The downstream portions of both the main east-west interceptor and a north-south line into the lagoon system are at capacity according to Town officials. The sewer system includes one lift station, but the length of the system is not known. No improvements are planned at this time.

2.6.2.2.5 Scottsbluff, Nebraska

Scottsbluff is a community of 14,440 (1983) located on the North Platte River. The community has a sanitary sewer system with a capacity rated by the City's Sewer and Water Superintendent as adequate. Ninety percent of the collection system is separate, and 10 percent is combined, meaning that the combined system carries both sanitary sewage and storm runoff.

The City operates a treatment plant consisting of aerated lagoons and microscreens. The design capacity of the plant is 3.14 mgd, and it currently receives an average daily flow of 2.50 mgd. Discharge is into the North Platte River. The average-day remaining capacity of 0.64 mgd (3.14 mgd - 2.50 mgd) is sufficient to serve an additional 3,699 people (640,000/173 gpcd).

The treatment plant currently receives a peak-daily flow of 3.4 mgd, which is greater than its design capacity (3.14 mgd); but such a condition is typical, since plants are normally designed to handle a hydraulic load of 2 to 3 times the average design discharge for which most efficient biochemical performance is achieved. Sludge is removed from the lagoons periodically.

The City's wastewater system operates with an annual budget of $566,545 and a staff that averages 7.3 full-time employees. Services are provided to residential customers at a rate of $2.80 per household per month. This is the minimum rate the City reported. Presumably, large commercial or industrial water users are charged more. The tap-in fee for a new home is $20.

2.6.2.2.6 Torrington, Wyoming

The Town of Torrington operates a lagoon system for waste treatment. The lagoon system consists of 4 cells and covers an area of 64 acres. The average depth is 5 feet. These 320 acre-feet (acre-ft) of storage are equivalent to 104.3 MG of waste storage volume. Average flows to the lagoons have been estimated by the Town to be between 0.5 and 0.6 mgd. For 5,540 people in 1983, this flow range indicates a per capita contribution of roughly 100 gpcd, and by inference the average flow is 0.554 mgd. Hence, there are 188 days (104.3/0.554) of storage available in the lagoon system.

CAPDET modeling has indicated that the existing ponds have a capacity for treating 1.2 mgd of waste as a facultative lagoon system with a discharge. So far the Town has avoided having a discharge. It would prefer to continue avoiding one, since discharge would require expensive monitoring and compliance reporting regarding its discharge requirements. A local study to explore the options to treatment-with-discharge (for which considerable excess capacity exists, 1.2 - 0.55 = 0.65 mgd) is scheduled to begin in the summer of 1984. The most apparent option would be expansion of the lagoon system for which the Town has available an additional 80 acres of land.

2.6.2.2.7 Wheatland, Wyoming

Wheatland operates a three-cell lagoon system for treatment of the town's wastewater. The first cell is a 6.6-acre aerated cell, followed by 2 unaerated cells of 14.9 and 8.74 acres. The 8.74-acre cell was added in 1978 to accommodate growth associated with the construction of the Laramie River Power Station. The lagoon system discharges to Rock Creek, a Class III stream. As a result, Wheatland must monitor for ammonia in the lagoon effluent and is limited by its discharge permit to discharging only 0.5 mgd, although the lagoon system can treat more wastewater. Currently, the flow through the lagoon system is estimated at 0.31 mgd. There is no flow recorder.

The sanitary sewer system is rated as good by Town officials. The lines range from 6 to 8 inches in diameter with a total length of approximately 30 miles.

2.6.3 Solid Waste

2.6.3.1 Cheyenne Urban Area

2.6.3.1.1 City of Cheyenne

The City of Cheyenne operates a Department of Sanitation with overall responsibility for the collection of solid wastes within the city. The Department currently owns and operates thirteen 25-cy rearloading packer vehicles, 1 container truck, and 1 roll-on/roll-off container truck, in

addition to spare, back-up equipment used to serve the city's residents and businesses. Collection frequency is once per week with 3-man crews operating on a 6 day-per-week basis.

City officials estimated that the landfill is currently accepting about 185 tons per day, which include wastes collected by private haulers serving the city of Cheyenne and other neighboring communities. An average of 150 tons per day of solid waste is collected by the Department of Sanitation for disposal at the sanitary landfill. The City's landfill operation is currently able to dispose of 175 tons per day with 200 to 250 tons per day capacity available for short durations. The Division of Streets and Alleys operates the landfill, and its equipment for landfill operation includes two tracked vehicles (one each Caterpillar D6 and D7), two wheeled tractor-scrapers (one self-propelled, the other towed by the D7), and a landfill compactor.

The City's waste disposal site is a landfill located 11 miles to the west of the city on Happy Jack Road. The site extends over approximately 1,100 acres of which 30 acres have been filled since 1966. Based on this rate of usage, the site's useful life has been estimated at 70 to 100 years. The site has been designed to accept all forms of household and commercial wastes, discarded appliances, construction and demolition debris, and vegetative wastes. No toxic or hazardous wastes are accepted for disposal. Cover material is readily available at the site. As a result of recent legislation, the landfill is required to obtain an operating permit from the State. The operating permit application for the site is being processed by the Wyoming Department of Environmental Quality. Issues to be resolved include modification of the existing landfill's operating procedures and evaluation of groundwater contamination potential. Preliminary results from a recent monitoring program have not detected any groundwater contamination. Nonetheless, the State would prefer that the landfill site be moved or that the City cease supplying public water supplies from wells in this immediate area. Various mitigations of this matter are being sought by State and local officials.

The City is currently evaluating the benefits and costs associated with adding a waste transfer station to its operations. Such a station, currently in the planning stages, would be designed and located to increase the efficiency of waste collection and disposal by reducing the frequency of hauling to the landfill. Several alternative sites for the station are currently under consideration.

2.6.3.1.2 South Cheyenne and Urban Fringe Areas

Two private waste-hauling companies, Bronco Disposal Service and Fox Sanitation Company, serve areas outside Cheyenne's city limits. Bronco Disposal operates throughout southern Laramie County, concentrating principally within the South Cheyenne area. The company serves over 500 residences and 100 commercial clients in addition to F.E. Warren AFB. Included within these totals are clients in the eastern portion of the county.

Bronco Disposal owns and operates four 20 cy rear-loading packer trucks (3 are used daily with 1 held as a spare). The equipment is stored and maintained at the company's office in Cheyenne. Crew size varies between 2 and 3 workers depending on the particular collection route.

All wastes collected by Bronco Disposal (including those from F.E. Warren AFB) are disposed at the Cheyenne landfill. Bronco Disposal delivers an average of 14 truckloads of waste per week to the Cheyenne landfill. Of these, 6 originate from F.E. Warren AFB and 8 are from county customers.

Bronco Disposal's collection frequency varies according to specific client needs. Residential clients may choose between once-per-week service (at \$14.00/month) or once-per-month service (at \$10.00/month). Commercial clients are served according to individual needs (at \$30.00/month per dumpster).

Fox Sanitation Company operates throughout Laramie County excluding the area within Cheyenne's city limits. The company estimates that it serves a population of 1,000, along with 400 commercial clients.

Fox Sanitation owns and operates three rear-loading collection trucks (two 20 cubic yarders and one 25 cubic yarder). Of the three trucks one is usually used as a spare. The company also uses one roll-on/roll-off truck to carry a number of 20 and 30 cy containers. All vehicles are stored and maintained at the company's office in Cheyenne. Two-man crews perform the collection service.

Fox Sanitation delivers an average of one truckload of waste each day (five truckloads per week) to the Cheyenne city landfill. Collection frequency varies according to specific client needs. Residential clients may choose between once-per-week, twice-per-week, or once-per-month collection (at a cost from \$8.50 to \$16.00 per household per month). Commercial clients may also choose among a variety of collection frequencies up to five collections per week. Commercial collection fees can be \$40 to \$50 per month, depending on waste collection frequency, quantities collected, and the distance to the disposal site.

2.6.3.1.3 Toxic and Hazardous Wastes

Toxic and hazardous waste generators in the private sectors in the ROI currently ship these materials out of state for safe disposal, in accordance with applicable state and federal laws and regulations.

F.E. Warren AFB is a "small quantity generator" of hazardous and acutely hazardous materials as defined by the Resource Conservation and Recovery Act. This means it produces and stores at its site less than 1,000 kilograms (kg) or 2,200 pounds of hazardous wastes and less than 1 kilogram of acutely hazardous wastes per month; and unlike larger generators, the base is not limited to storage of 90-days' generation of these materials. In fact, F.E. Warren generates and stores about 500 pounds per month of a dilute solution of sodium chromate from the Minuteman missile support equipment. All other hazardous wastes produced at the base are routinely sold for recycling or are hauled away for reclamation. These include 500 gallons per month of contaminated fuels and spent lubricants, 275 gallons of contaminated helicopter fuel (JP4), and a very small quantity of spent battery acid. (Quantities of reclaimed and recycled materials, such as these, are permitted by the regulations to be excluded from the quantity determination of amounts a generator may generate and store.)

2.6.3.2 All Other Communities

2.6.3.2.1 Chugwater, Wyoming

Chugwater owns and operates a single collection vehicle which is used for twice-monthly waste collections. The residents incinerate their own garbage and set out the ashes and noncombustibles for periodic collection. The fee is $2.00 per month.

The town uses a landfill site roughly 3 miles east of town. The site is situated in a canyon. It covers an area of about 200 feet in diameter and is 60 feet deep (a volume of about 40 acre-ft). The landfill has been in use for about 50 years and currently is filling at a rate of 2 feet per year. The site is used for household and commercial wastes, trees and other vegetative wastes, discarded appliances, tires, and similar urban jetsam. However, no industrial, chemical, or hazardous wastes are accepted for disposal.

Citizens of the region surrounding Chugwater are permitted to use the disposal site as well, but they must make their own arrangement for delivery.

The Platte County Commission is currently considering the feasibility of establishing a regional landfill, which Chugwater could also use. Planning is very preliminary.

2.6.3.2.2 Gering, Nebraska

Gering contracts with a private firm to collect all solid wastes within the city limits. The firm, Heimbuck Disposal, collects wastes from 311 commercial accounts and 2,700 residential accounts (1983 population is 8,560) for disposal at the Gering municipal landfill. Collections are performed on a once per week basis with two 25-cy and two 30-cy side-loading packer vehicles. More frequent collections are provided as necessary. Vehicles are operated by one-man crews.

An average of 26 loads of solid waste per week is collected by Heimbuck. Some additional wastes are brought by private individuals and businesses directly to the landfill for disposal. This landfill, owned and operated by the City since 1972, is located approximately 3 miles west of the city. The site extends over 37.4 acres and has had a maximum of 10 acres filled during the past 11 years. The site has been designed and licensed to accept all forms of household and commercial wastes, discarded appliances, construction and demolition wastes, wood products, and tires. No industrial, chemical, or toxic/hazardous wastes are accepted for disposal at the landfill. Cover material is readily available at the site.

The City of Gering employs five people to operate the landfill, and one person is responsible for administration of the overall system. Heimbuck Disposal employs 1 part-time and 3 full-time employees. Revenues to the solid waste system will be about $197,000 in 1983, with $149,500 earmarked for Heimbuck for the collection service. The remaining $37,500 will serve to meet other operating expenses. Fees for residential collections are $4.50 per month, with commercial accounts somewhat higher, depending on quantity of wastes and frequency of collection. A separate fee schedule is in effect for individuals disposing directly at the landfill.

2.6.3.2.3 Kimball, Nebraska

The City of Kimball does not operate a public solid waste collection system. It contracts with a private firm (Western Salvage) which serves all residents and businesses (100 commercial accounts) with one 18-cy rear-loading compactor vehicle and one 30-cy side-loading vehicle. These are owned and maintained by Western Salvage. Collections are performed with one-man crews on a once-a-week basis with additional collections available on demand.

An average of eight to nine truckloads of waste is deposited weekly at the City-owned sanitary landfill which is also operated under private contract with Kimball. This landfill, located approximately 1 mile west of the city, covers 98 acres, of which 80 acres are available for landfilling. This is a newly opened landfill accepting all forms of household and commercial wastes, construction debris, discarded appliances such as refrigerators and stoves, tires, and vegetative wastes. No chemical, industrial, toxic, or hazardous wastes are accepted for disposal. Cover material is readily available at the site. It is expected that under current operating conditions this site will have capacity for 40 to 50 years. The landfill is ringed by a security fence with a control gate.

The work force necessary to operate the solid waste system includes one employee of Western Salvage (collection), one employee for landfill operations (private contract), and one administrative officer (Kimball). Fees for residential collection are $6.00 per month per residence with a separate fee structure for commercial generators and individuals disposing directly at the landfill.

2.6.3.2.4 Pine Bluffs, Wyoming

Pine Bluffs contracts with private firms to collect, transport, and dispose of all solid wastes. LarCo Disposal Inc., currently under contract to Pine Bluffs, serves 693 separate residential and commercial accounts (1983 population = 1,117) with a single 20-cy rear-loading compactor vehicle owned and maintained by LarCo. Collections are performed in residential neighborhoods twice weekly, with commercial establishments receiving garbage collection services up to six times per week. All collections are performed by a one-man crew.

An average of five truckloads of solid waste per week is collected by LarCo for disposal at the Town-owned landfill. An additional one to two loads of waste per week are brought by private individuals directly to the landfill for disposal.

LarCo also operates the landfill. This landfill, located 0.5 mile west of the town, accepts all forms of household and commercial wastes, discarded appliances such as stoves and refrigerators, and vegetative wastes. No industrial, chemical, toxic, or hazardous wastes are accepted for disposal at the landfill.

The present landfill has an estimated 2 to 3 years of remaining capacity (at current disposal levels). Upon its closure, wastes are to be transported to a new site near Burns, Wyoming.

Fees for residential collection are $6.00 per month and range up to $12.00 per month for commercial collection (depending on waste quantities and collection frequency). LarCo's contract is valued at $37,200 per year.

2.6.3.2.5 Scottsbluff, Nebraska

The Scottsbluff Department of Sanitation is responsible for the collection, transport, disposal, and overall administration of solid waste operations within Scottsbluff. The Department currently owns, operates, and maintains two 18-cy, rear-loading packer vehicles used to serve the 698 commercial accounts, plus three 20-cy, side-loading packer vehicles to serve the 5,837 residential accounts (1983 population is 14,156). An additional 562 individuals and businesses haul wastes directly to the City-owned sanitary landfill. Collection frequency is twice per week throughout the city with two-man crews serving the commercial accounts and one-man crews used for the residential districts.

An average of 12 truckloads of solid waste is delivered daily to the City's landfill. This landfill, located approximately 5 miles to the east of the city, extends over 160 acres with some 35 acres actively being filled. Approximately 2 acres per year are required to meet disposal needs. The landfill is designed and licensed to accept all forms of household and commercial wastes, construction and demolition debris, discarded appliances, stripped automobiles, tires, and vegetative wastes (such as tree limbs). No chemical wastes, toxic and hazardous wastes, or industrial wastes are accepted for disposal. Cover material is readily available at the site. The landfill is ringed by a security fence with a central gate. A litter fence is also used to minimize windblown debris.

The Scottsbluff Department of Sanitation employs a total of 13 people and has an annual collection budget of $457,340 (1983). Fees for residential collection are $4.50 per month and $10.10 per month for commercial accounts.

2.6.3.2.6 Torrington, Wyoming

Torrington operates a Department of Sanitation which has overall responsibility for the collection and disposal of all solid wastes generated within the town. The Department owns and operates four rear-loading vehicles (two used as back-ups or spares) for waste collection. Collection occurs three times per week for residences and up to six times per week for commercial establishments. While two and three-man crews are currently employed, the Department is anticipating a one-man crew operation in the future.

The Torrington solid waste system employs a baling facility for waste processing and a sanitary landfill for ultimate disposal. The baler, constructed in 1977, reduces the town's daily wastes to an average of 11 compacted bales (of approximately 1 ton each), which are in turn loaded onto a flatbed truck and transported to the Town-owned balefill (landfill). The balefill extends over an area of 60 acres and employs a trench disposal method whereby baled wastes are stacked within an excavated trench. Cover material, taken from the trench, is spread over the waste. A second trench is also used for wastes that arrive in an uncompacted form. The balefill accepts all household and commercial wastes along with wood wastes (which are permitted to be burned in a separate area of the site). No chemical, toxic,

or hazardous wastes are accepted. Automobiles and discarded appliances are not accepted but are directed to nearby scrap metal reclaimers.

The Department of Sanitation employs a total of 10 persons in collection, baler, and landfill operations, and for administration and management. The Department is provided with a total 1983 budget of $325,900, of which $214,100 are earmarked for employee compensation, $27,700 for materials and supplies, $72,100 for capital improvements and equipment, and $8,000 for baler expenses, among other costs. Fees for collection are $6.25 per residence per month, $12.50 per commercial account per month, and $31.25 per dumpster per month. A separate fee structure exists for those disposing directly at the landfill.

Torrington Disposal Service is responsible for solid waste collection within the unincorporated area surrounding Torrington. Torrington Disposal collects solid wastes from approximately 450 residential customers and 100 commercial customers, using 2 rear-loading compactor vehicles with a 1-man crew. Approximately 14 tons per week are collected and buried at a separate landfill site. The company will soon be receiving government approval to establish its own separate landfill site.

2.6.3.2.7 Wheatland, Wyoming

Wheatland maintains its own Department of Sanitation. The Department counts chief among its duties the collection and disposal of solid wastes, employing four rear-loading collection vehicles and a seven-man collection crew. Collections occur twice weekly within the town's residential neighborhoods (1983 population is 4,520), and up to six times per week for some restaurants and commercial establishments.

Approximately 80 tons of waste are collected each week, with all wastes transported to the City's 49.75-acre sanitary landfill. This landfill currently has 5 years of capacity remaining (assuming present disposal levels). The City is acquiring an additional 30 acres to extend the landfill's life by 25 years. The landfill is designed and approved to accept all forms of household, commercial, and similar wastes. No toxic, hazardous, chemical, or industrial wastes are accepted for disposal. Cover material is available on the site in sufficient quantities.

The Department employs a total of 8 persons and has an annual budget of $156,570 (1982 to 1983). Fees for collection range from $6.00 per month per residence up to $125 per month per commercial establishment, depending on frequency of collection.

2.6.4 Stormwater

2.6.4.1 Cheyenne Urban Area

2.6.4.1.1 Rational Method Analysis

Very little information was available about storm sewers currently in place, either in the Cheyenne Urban Area or elsewhere in the ROI. Therefore, the following Rational Method analysis as initially performed (in some cases admittedly outside its area of applicability for rigorous analysis) merely to

estimate the relative quantities of storm runoff that must be occurring in the various parts of the ROI, as well as to estimate the sizes of storm sewer systems that one would normally anticipate to be in place, whether they actually are or not. In Section 3.0 it will be noticed that the Cheyenne Urban Area's storm sewer needs for new development areas, both in baseline and project conditions, have been analyzed with great rigor according to Cheyenne's own drainage criteria. For now, however, the following analysis is presented merely as an estimate of what must be occurring today.

Rainfall data for the city of Cheyenne, collected at the Cheyenne Airport over roughly 30 years, have been analyzed and are reported in Table 2.6.4-1. These data and the regional intensity relationship reported earlier were consulted to derive rainfall intensities (in/hr) for storm events of various durations. A duration of 4 hours and a corresponding 0.3 in/hr intensity for a 2-year storm were ultimately selected for the entire Cheyenne Urban Area. This design storm was applied via the Rational Method ($Q = CiA$) to the developed and developing areas (about 16,000 acres in total) of the Cheyenne Urban Area.

The runoff coefficients (C-values) used for the Cheyenne Urban Area (and all other affected communities) are given in Table 2.6.4-2.

The results of the Rational Method computations for peak storm runoff flow rates are given in Table 2.6.4-3. Also shown in the table are the numbers of separate storm sewer lines that would be necessary to transport the indicated flow rates. For example, N_{60} is the number of storm sewers with 60-inch diameters that would be required to transport the computed peak flows.

Cities typically place costly storm sewers in their commercial areas where flooding and drainage damage would be the highest. Because cities often eschew the use of storm sewers in less densely populated residential areas, preferring to use roadway swales, culverts, or roadside ditches, a computation has been made to indicate the number of storm sewers necessary to drain only a portion of Cheyenne and the other communities. It has been assumed here that storm sewers would be judged to be absolutely essential in only 40 percent of the urbanizing area. Accordingly, values of 40 percent of N_{60} ($N_{60}/2.5$) are also shown in Table 2.6.4-3. (It may be noted that C-value differences were not included for these smaller areas, although it might be argued that the commercial areas are likely to be more densely developed and more impervious than the balance of the region. Nonetheless, that was an embellishment considered unnecessary in this planning analysis with the admittedly imprecise Rational Method.)

The peak runoff rate for all 16,000 acres in the Cheyenne Urban Area was estimated to be 2,880 cfs. The analysis indicated that 53 separate 60-inch storm-sewer outfalls would be necessary to accommodate this peak flow. It was also shown that 21 separate storm sewers equivalent in flow capacity to 60-inch pipes would be necessary to drain the smaller presumably more valuable downtown and surrounding area.

A special area of concern in the Cheyenne Urban Area is South Cheyenne, where very flat terrain frequently floods and water stands for hours over extensive areas as deep as 12 inches. Clearly that area is not currently drained adequately either by storm sewers or by natural drainageways, although there are some 24-inch storm drains in that area.

Table 2.6.4-1

INCHES OF RAINFALL FOR VARIOUS FREQUENCIES
AND STORM DURATIONS - CHEYENNE, WYOMING

Storm	Recurrence Interval					
Duration	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
5 Min	0.246	0.358	0.435	0.529	0.621	0.704
10 Min	0.382	0.556	0.675	0.821	0.963	1.09
15 Min	0.484	0.704	0.855	1.04	1.22	1.38
30 Min	0.671	0.976	1.18	1.44	1.69	1.92
1 Hr	0.850	1.24	1.50	1.82	2.14	2.43
2 Hr	0.987	1.38	1.65	1.97	2.29	2.58
3 Hr	1.09	1.48	1.75	2.08	2.40	2.70
6 Hr	1.25	1.65	1.92	2.36	2.58	2.88
12 Hr	1.42	1.85	2.14	2.58	2.84	3.15
24 Hr	1.59	2.05	2.35	2.79	3.09	3.42

Source: NOAA, Precipitation - Frequency Atlas of the Western United States, Vol. 2, Wyoming, prepared for USDA, Soil Conservation Service, 1973.

Table 2.6.4-2

BASIC DATA TO SUPPORT RUNOFF ANALYSES
IN THE AREAS OF CONCENTRATED STUDY

Community	Approximate Developed Area, Acres, A	Storm Duration, hr	Rainfall Intensity, in/hr, i	Runoff Coefficients[1], C								
				General Urban			Urban-Res.			Suburb.-Res.		
				R	M	F	R	M	F	R	M	F
Cheyenne Urban Area	16,000	4	0.3		0.6							
Gering	1,000	1	0.9			0.5						
Kimball	1,000	1	0.9					0.5				
Pine Bluffs	1,000	1	0.9								0.4	
Scottsbluff	3,160	2	0.5			0.5						
Torrington	1,500	1	0.9								0.4	
Wheatland	1,000	1	0.9								0.4	

Note: 1 Ranges of Values: General Urban 0.5 - 0.7
Urban-Residential 0.4 - 0.6
Suburban Residential 0.3 - 0.5

R = Rolling terrain
M = Moderate slopes
F = Flat slopes

Table 2.6.4-3

COMPUTED RUNOFF RATES AND ESTIMATED NUMBERS OF REQUIRED STORM SEWER OUTFALLS FOR VARIOUS COMMUNITIES

Community	C	i	A	Q(cfs)	N_{48}[a]	N_{60}[b]	$N_{60}/2.5$[c]
Cheyenne Urban Area	0.6	0.3	16,000	2,880	95	53	21
Gering	0.5	0.9	1,000	450	15	8	3
Kimball	0.5	0.9	1,000	450	15	8	3
Pine Bluffs	0.4	0.9	1,000	360	12	7	2
Scottsbluff	0.5	0.5	3,160	790	26	15	5
Torrington	0.4	0.9	1,500	540	18	10	3
Wheatland	0.4	0.9	1,000	360	12	7	2

Notes: a N_{48} = number of equivalent 48-inch storm sewers.

b N_{60} = number of equivalent 60-inch storm sewers.

c $N_{60}/2.5$ = number of equivalent 60-inch storm sewers to drain the most built-up part of town, assumed to be 40 percent of the urban area, and in which flood damages would be most worthy of averting with storm sewers.

A repeat of the Rational Method computation for that area alone was made. For the estimated 320-acre area of development in South Cheyenne, a 1-hour, 2-year event (0.9 in/hr) and a C-value of 0.4, the Rational Method indicated a peak runoff rate of 115 cfs. This would require the equivalent of two 60-inch storm-sewer outfalls for this area. Data for the storm sewers actually in place in South Cheyenne were not available to compare to this equivalent capacity, but the chronic drainage problem was noted.

It is also to be noted that storm sewers are required by local ordinance for new-construction areas throughout the Cheyenne Urban Area, and they must be sized to store temporarily, or to pass to nearby streams, a peak flow equivalent to the 10-year event. This is a more demanding design event (productive of higher peak flows) than the 2-year design event used here.

2.6.4.1.2 SWMM Simulations for Developed Areas

Cheyenne officials in the Department of Streets and Alleys had reported that existing storm sewers in the most developed parts of Cheyenne (in built-up areas tributary to Crow Creek) already experience periodic flooding and drainage problems. Storm sewers exist in these subareas, but they were feared by these officials to be inadequate. Moreover, invert elevations and diameters for many of these sewers were not available to check the hydraulic capacity of these sewers or to analyze their degree of deficiency.

Accordingly, in this study a field-surveying effort was mounted to determine some of the basic data, and the SWMM model was prepared to simulate several design storm events as imposed on these existing pipe systems.

There are about 5 separate storm sewer lines in the developed parts of Cheyenne which are tributary to Crow Creek. The two-week surveying effort was able to get measurements in detail on the most extensive one of these in the downtown area, and U.S. Geological Survey (USGS) maps and City maps were adequate to determine sizes and slopes for a second pipe system in eastern Cheyenne. These two pipe systems as schematicized for modeling purposes are shown in Figure 2.6.4-1.

Initial simulations were made for these drainage basins with 3-hour storm inflows for 2 and 10-year recurrence intervals. Rainfall distributions over the 3-hour period (hyetographs) for these storms were derived from 3-hour hyetographs used by engineers in the Denver-Cheyenne region for storm sewer design.

For the Downtown system, the 2-year storm caused a surcharge condition for 30 minutes of the simulated 3-hour rain period. The model revealed that the 84-inch outfall at the downstream end of the network would have to be increased to 102 inches to accommodate the peak discharge of 631 cfs. The 10-year storm surcharged the 84-inch outfall longer (50 minutes), and the peak flow was nearly twice as large (1,133 cfs). To accommodate this flow, the model indicated that the 84-inch pipe would have to be replaced with one having a diameter of 126 inches.

The East Cheyenne system had similar problems with 2 and 10-year events. The existing 48-inch outfall was shown to be surcharged for 50 minutes by the 421-cfs peak runoff from a 2-year, 3-hour storm. To accommodate this flow,

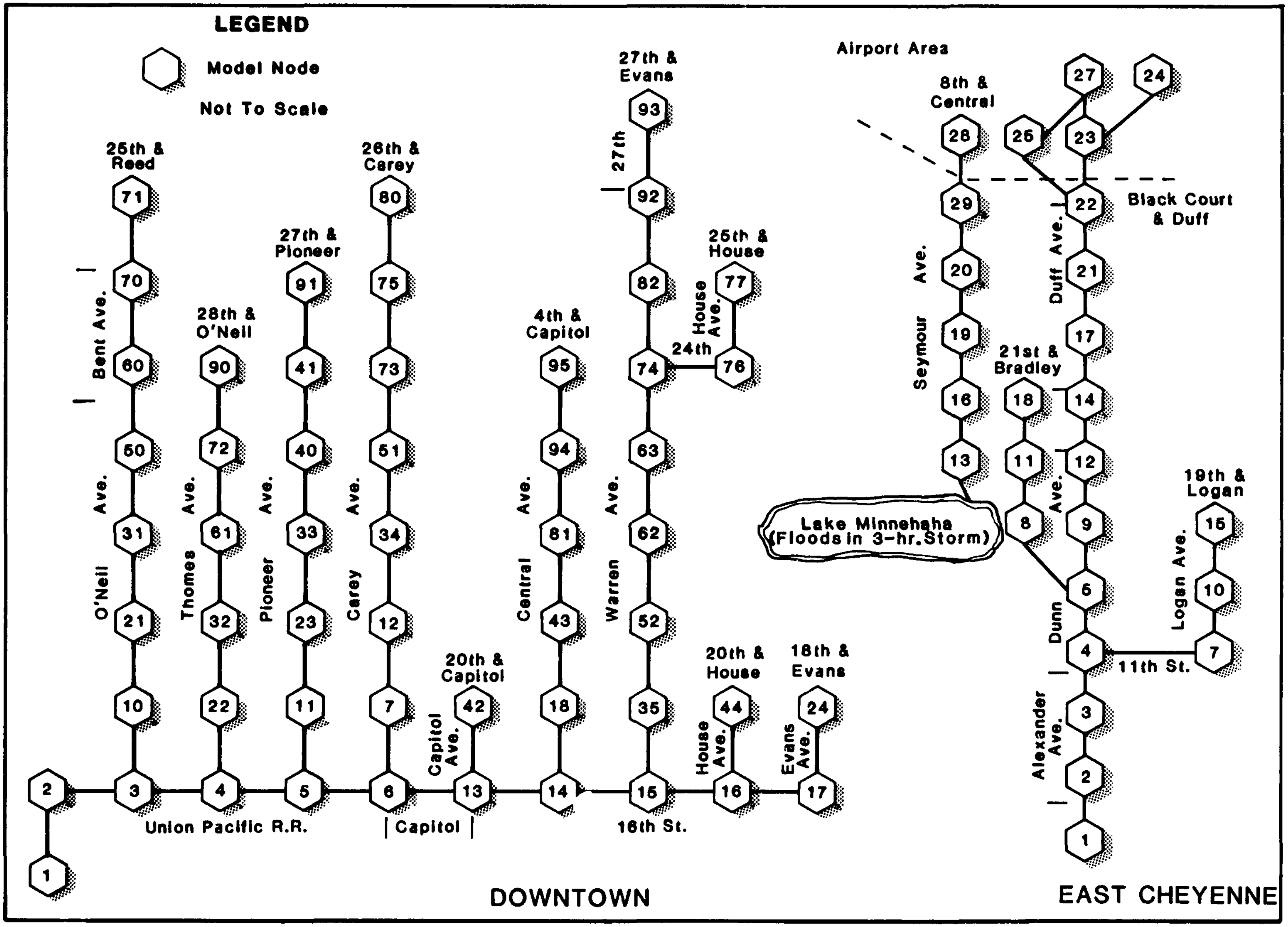


FIGURE 2.6.4-1 SCHEMATICS OF DOWNTOWN AND EAST CHEYENNE STORM DRAIN SYSTEMS MODELED BY COMPUTER

the pipe would have to be replaced with a 78-inch outfall. Similarly, the 48-inch pipe was surcharged for 70 minutes in a 10-year event, and the pipe had to be increased to one with a diameter of 96 inches to contain the 736 cfs peak flow.

Later a 24-hour, 2-year storm with a substantially lower average intensity (1.59 in/24 hr = 0.066 in/hr) was modeled for the two systems. In this case, the downtown system was able to accommodate the 245 cfs peak flow rate with the existing 84-inch outfall. The East Cheyenne system, however, still surcharged for 20 minutes, and a 66-inch outfall had to be used to accommodate the 171 cfs flow.

It is emphasized that local ordinances for new development areas require that sufficient storm drainage facilities be installed such that a 100-year event will be limited in outflow to 10-year predevelopment levels. Hence, the deficiencies noted in these two fully developed areas of Cheyenne result from preexisting conditions of design and development. Clearly, though, storm drainage planning for improvements in storm sewers in the developed parts of town should commence. But it should be emphasized as well that project-induced populations are not being allocated to the developed parts of Cheyenne, so there can be no stormwater impact there, even an exacerbation of these preexisting deficiencies. Project-induced inmigration is being allocated to South Cheyenne and northern and eastern growth areas of Cheyenne where the existing ordinances should dictate provision of adequate storm drainage facilities.

2.6.4.2 All Other Communities

2.6.4.2.1 Chugwater, Wyoming

Chugwater officials report that there is little need for storm sewers in their town, although there are about 500 feet of such pipes in place. The entire town is well drained to Chugwater Creek.

2.6.4.2.2 Gering, Nebraska

Gering is currently drained primarily by surface drainage (such as roadway swales and drainage ditches), although new subdivisions are required to have storm sewer systems. There is a perceived need among local officials for more storm sewers than the city currently has.

As shown earlier in Table 2.6.4-3, developed areas of Gering can generate as much as 450 cfs of peak runoff in a 2-year storm event. This would require eight 60-inch storm sewers. For the most-developed, commercial part of town, approximately 3 equivalent 60-inch outfalls would be required.

While 0.9 inch per hour was the projected 1-hour rainfall intensity for a 2-year storm, rainfall data from nearby Torrington, Wyoming, suggest that a 1-hour, 2-year storm would amass 1.04 inches of rain. The 100-year, 24-hour rainfall in Torrington is 4.3 inches. Hence, larger events than the design rainfall used here are possible.

2.6.4.2.3 Kimball, Nebraska

Kimball has a number of 15 to 30-inch storm drains and a concrete ditch to the north of town designed for 20-year events. In the southwest part of town, sewers occasionally become clogged with sediment, and an annual cleaning program has been started.

As shown previously in Table 2.6.4-3, the developed area of Kimball would experience a peak runoff rate in a 2-year storm of 450 cfs. Eight equivalent 60-inch outfalls would be necessary to drain the entire city, and three 60-inch outfalls or the equivalent would be required to drain the commercial part of town.

While 0.9 in/hr was computed from regional data to be the 2-year rainfall intensity for Kimball, other weather data for gages near Pine Bluffs indicate that the 1-hour, 2-year storm equals 0.99 inch of rain. The 100-year rainfall over a 24-hour period would be 3.8 inches. Hence, larger events than the design rainfall used here are possible.

2.6.4.2.4 Pine Bluffs, Wyoming

Pine Bluffs experiences frequent flooding caused by storm runoff. There are some storm sewers in part of the city; but there is less than a mile of storm sewers in total, with diameters ranging from 18 to 36 inches.

An intensity of 0.9 in/hr was estimated for Pine Bluffs from the regional intensity-duration relationship as the intensity of a 2-year, 1-hour storm. Rain gages near Pine Bluffs, however, indicate that the 2-year, 1-hour storm actually amasses 0.99 inch. Also, the 50-year, 24-hour rainfall from those records would total 3.4 inches. Thus, larger events than the design storm used here can occur. The Pine Bluffs rainfall records are given in Table 2.6.4-4.

2.6.4.2.5 Scottsbluff, Nebraska

Scottsbluff has a storm sewer system throughout much of the city. Seven storm outfalls, ranging in size from 18 to 60 inches, drain to the North Platte River. Most were designed for the 2-year event, but local study is under way to determine the adequacy of the system and to plan future expansions.

As shown earlier in Table 2.6.4-3, the developed area of Scottsbluff experiences a peak runoff rate in a 2-year storm of approximately 790 cfs. Fifteen equivalent 60-inch storm sewers would be necessary to drain that much water from the entire city. Five would be necessary to drain 40 percent of the city, which has been assumed here to be the more built-up, commercial area of town where storm sewers are usually installed. Scottsbluff has 7 outfalls, of which 3 are 60-inch sewers. Other outfalls include an 18-inch, a 20-inch, a 42-inch and a 48-inch sewer.

While 0.5 inch per hour was projected from regional data as the 2-hour rainfall intensity for a 2-year storm, rainfall data from nearby Torrington, Wyoming, suggest that a 2-hour, 2-year storm would amass 1.14 inches of rain, which indicates an average intensity of 0.57 in/hr. The 100-year rainfall over a 24-hour period in Torrington is 4.3 inches. Hence, larger events than the design rainfall used here are possible.

Table 2.6.4-4

INCHES OF RAINFALL FOR VARIOUS FREQUENCIES
AND STORM DURATIONS AT PINE BLUFFS, WYOMING

Storm	Recurrence Interval					
Duration	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
5 Min	0.287	0.409	0.490	0.597	0.690	0.799
10 Min	0.446	0.634	0.760	0.927	1.07	1.24
15 Min	0.564	0.804	0.963	1.17	1.36	1.57
30 Min	0.782	1.11	1.34	1.63	1.88	2.18
1 Hr	0.990	1.41	1.69	2.06	2.38	2.76
2 Hr	1.13	1.58	1.86	2.24	2.59	2.94
3 Hr	1.23	1.70	1.99	2.38	2.75	3.08
6 Hr	1.40	1.90	2.20	2.60	3.00	3.30
12 Hr	1.60	2.15	2.40	2.90	3.20	3.55
24 Hr	1.80	2.40	2.60	3.20	3.40	3.80

Source: NOAA, Precipitation - Frequency Atlas of the Western United States, Vol. 2, Wyoming, prepared for the USDA, Soil Conservation Service, 1973.

2.6.4.2.6 Torrington, Wyoming

Torrington has 8 to 48-inch storm sewers which drain to the North Platte River. They were designed originally for the 5-year event. City officials report that while storm sewers are in fair shape, they flood quite frequently. No expansions or improvements are planned.

As shown earlier in Table 2.6.4-3, the developed area of Torrington would develop 540 cfs of peak runoff in a 2-year event, and would require the equivalent of ten 60-inch storm sewers to drain the entire peak flow. Three such sewers would be required to drain the commercial section of town. There are 48-inch outfalls in place now, but the number of separate lines was not reported.

While a 0.9 in/hr rainfall intensity was computed for Torrington from the regional data, other weather data for gages closer to Torrington indicate that the 1-hour storm every 2 years on the average equals 1.04 inches of rain. The 100-year rainfall over a 24-hour period would be 4.3 inches. Hence, larger events than the design rainfall used herein are possible. The local rainfall data for Torrington are given in Table 2.6.4-5.

2.6.4.2.7 Wheatland, Wyoming

Most of Wheatland does not have storm sewers. The town is served primarily by swales paved into its roadways and by drainage ditches. There are about 5,000 feet of storm sewers in the 8 to 15-inch range. Local officials have reported the community does not experience serious flooding, and they view the town as protected against the 50-year event.

Based on a regional intensity-duration equation, 0.9 in/hr was derived for the 2-year storm in Wheatland. Other rainfall data from gages near Wheatland indicate that the 2-year, 1-hour storm amasses 0.83 in/hr. The 5-year frequency event is 1.21 in/hr, so the 0.9 in/hr value is not an unreasonably conservative estimate. Since the 50-year, 24-hour storm will amass 3.1 inches of rainfall, larger events than the design storm used here are quite possible. Rainfall data measured locally for Wheatland are given in Table 2.6.4-6.

2.6.5 Telephone Service

2.6.5.1 Cheyenne Urban Area

Mountain Bell provides telephone service to Cheyenne and its surrounding area, including F.E. Warren AFB. The rate of growth of new customers in the past 5 years has varied from 3 to 8 percent. In 1982, Mountain Bell served 33,183 customers. (A customer is a telephone number billing, which should not be confused with either a separate phone instrument or an individual.) Excess capacity in the central office exists to serve an additional 1,150 local telephone customers.

F.E. Warren AFB has a small central telephone exchange of its own. This facility handles 450 Air Force telephone lines. An additional 50 lines are routed directly into the citywide Mountain Bell system. Another set of 1,300 line pairs serves the base housing complex, of which 1,030 pairs are

Table 2.6.4-5

INCHES OF RAINFALL FOR VARIOUS FREQUENCIES
AND STORM DURATIONS AT TORRINGTON, WYOMING

Storm Duration	Recurrence Interval 2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
5 Min	0.302	0.423	0.496	0.594	0.682	0.783
10 Min	0.468	0.657	0.770	0.922	1.06	1.22
15 Min	0.593	0.832	0.975	1.17	1.34	1.54
30 Min	1.822	1.15	1.35	1.62	1.86	2.13
1 Hr	1.04	1.46	1.71	2.05	2.35	2.70
2 Hr	1.14	1.57	1.83	2.21	2.54	2.90
3 Hr	1.23	1.67	1.94	2.35	2.70	3.07
6 Hr	1.45	1.90	2.20	2.70	3.10	3.50
12 Hr	1.65	2.15	2.50	3.05	3.45	3.90
24 Hr	1.85	2.40	2.80	3.40	3.80	4.30

Source: NOAA, Precipitation - Frequency Atlas of the Western United States, Vol. 2, Wyoming, prepared for USDA, Soil Conservation Service, 1973.

Table 2.6.4-6

INCHES OF RAINFALL FOR VARIOUS FREQUENCIES
AND STORM DURATIONS AT WHEATLAND, WYOMING

Storm Duration	Recurrence Interval 2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
5 Min	0.241	0.351	0.423	0.519	0.606	0.696
10 Min	0.374	0.544	0.657	0.806	0.940	1.08
15 Min	0.473	0.690	0.832	1.02	1.19	1.37
30 Min	0.656	0.956	1.15	1.41	1.65	1.90
1 Hr	0.830	1.21	1.46	1.79	2.09	2.40
2 Hr	0.922	1.31	1.57	1.92	2.22	2.52
3 Hr	1.00	1.39	1.67	2.03	2.33	2.63
6 Hr	1.20	1.60	1.90	2.30	2.60	2.90
12 Hr	1.40	1.80	2.15	2.55	2.85	3.15
24 Hr	1.60	2.00	2.40	2.80	3.10	3.40

Source: NOAA, Precipitation - Frequency Atlas of the Western United States, Vol. 2, Wyoming, prepared for USDA, Soil Conservation Service, 1973.

currently in use. Mountain Bell's cables onto the base serving all these needs are near capacity, and sizeable increases in service needs will require the stringing of new cable onto the base.

2.6.5.2 All Other Communities

2.6.5.2.1 Chugwater, Wyoming

Telephone service in Chugwater is provided by the Chugwater Telephone Company. There are approximately 140 to 145 telephone customers in Chugwater today. The central office has a capacity of 200 lines and 300 numbers. The basic charge for a single instrument customer ranges from $4.50 to $8.00 per month.

2.6.5.2.2 Gering, Nebraska

Telephone service in Gering is provided by United Telephone Company of the West. There are about 4,030 telephone customers in Gering today. The central office (in Gering) has capacity for approximately 250 additional customers.

The basic charge for a single-instrument residential customer is $8.35 per month.

2.6.5.2.3 Kimball, Nebraska

Telephone service in Kimball is provided by United Telephone Company of the West. There are about 2,230 telephone customers in Kimball today. The central office (in Kimball) has capacity for approximately 120 additional customers.

The basic charge for a single-instrument residential customer is $5.45 per month.

2.6.5.2.4 Pine Bluffs, Wyoming

Telephone service in Pine Bluffs is provided by Mountain Bell. There are 718 telephone customers in Pine Bluffs today. The central office (in Pine Bluffs) has capacity for approximately 60 additional customers. The average rate of new customer growth over the past 5 years has been about 0.5 percent (between 3 and 4 customers per year).

The basic charge for a single-instrument customer is $5.84 per month.

2.6.5.2.5 Scottsbluff, Nebraska

Telephone service in Scottsbluff is provided by United Telephone Company of the West. There are about 9,000 telephone customers in Scottsbluff today. The central office (in Scottsbluff) has capacity for approximately 700 additional customers.

The basic charge for a single-instrument customer is $8.35 per month.

2.6.5.2.6 Torrington, Wyoming

Telephone service in Torrington is provided by United Telephone Company of the West. There are about 4,200 telephone customers in Torrington today. The central office (in Torrington) has capacity for approximately 190 additional customers.

The basic charge for a single-instrument customer is $7.10 per month.

2.6.5.2.7 Wheatland, Wyoming

Telephone service in Wheatland is provided by Mountain Bell. There are about 3,065 telephone customers in Wheatland today. The central office in Wheatland has capacity for approximately 750 additional customers.

The basic charge for a single-instrument customer is $7.25 per month.

3.0

ENVIRONMENTAL CONSEQUENCES, MITIGATION MEASURES, AND UNAVOIDABLE IMPACTS

3.0 ENVIRONMENTAL CONSEQUENCES, MITIGATION MEASURES, AND UNAVOIDABLE IMPACTS

3.1 Analytic Methods for Future Conditions

3.1.1 Water Treatment and Distribution

3.1.1.1 Baseline Future - No Action Alternative

For each community that was an Area of Concentrated Study (ACS), water demands were computed as functions of current per capita usage rates and baseline-future populations. These demands were then compared to existing capacities of treatment and distribution facilities, and any needed expansions were indicated. Additionally, because the Cheyenne Urban Area, as defined for utilities, will receive by far the greatest project-induced population growth, detailed computer simulations with the Water System Simulation Model (WATSIM) were made to examine the basic delivery capacity and the firefighting capability of that region's distribution network. Needed expansions, if any, to serve the baseline growth were noted.

3.1.1.2 Proposed Action

For communities other than the Cheyenne Urban Area, current per capita usage rates were multiplied by the expected project-induced population to determine water demands. These demands in future years were compared with the capacities of facilities expected to be in place to serve the baseline, no-project demands. Additional needed facilities, if any, were noted. For the Cheyenne Urban Area, additional WATSIM simulations were made with the project demands imposed on the water distribution system. Needed facilities expansions, in addition to baseline facility needs, if any, were noted.

3.1.2 Wastewater

3.1.2.1 Baseline Future - No Action Alternative

For each ACS community, wastewater quantities have been computed as functions of current unit per capita rates of discharge and baseline-future populations. These waste flows were compared to existing capacities of waste treatment facilities, and any needed expansions were indicated. The Computer Assisted Design and Evaluation of Wastewater Treatment Systems (CAPDET) model was used for treatment plants in several communities. Additionally, detailed computer simulations with the Storm Water Management Model (SWMM) were made to examine the sanitary sewer networks in Cheyenne and South Cheyenne.

3.1.2.2 Proposed Action

The current unit factors of per capita waste flow were again multiplied by the project populations to determine the waste flows in future years with the project. These waste flows were compared with the facilities capacities expected to be in place in the baseline-future period, and further expansions, if any, were indicated. For the Cheyenne Urban Area, additional SWMM simulations were made with the project waste flows imposed.

3.1.3 Solid Waste

3.1.3.1 Baseline Future - No Action Alternative

Solid waste loads have been computed as functions of expected populations in baseline-future conditions and of unit, per capita waste generation rates. A nominal value of 5.0 pounds per person per day was used for all communities, and 2.76 pounds per person per day was used for F.E. Warren Air Force Base (AFB). These values were based on historical records from the area. Weekly-commuter and transient-population unit loads were taken to be 3.0 pounds per person per day, since these people will be in the area less than full time. Needed collection or disposal-site equipment or land expansions were noted.

3.1.3.2 Proposed Action

For each ACS community, solid waste quantities were computed from project populations and per capita unit loadings. Collection and disposal facilities needed in future years were compared with projected facilities for corresponding baseline years. Needed additions to equipment or crews were noted. Also indicated were earlier, accelerated needs for capacity expansions as compared with baseline conditions.

Waste loads of construction debris generated at F.E. Warren AFB during 1984 and 1985 were estimated from construction schedules and plans for various building sites.

3.1.4 Stormwater

3.1.4.1 Baseline Future - No Action Alternative

Peak-storm runoff rates were computed for those communities where project-induced inmigration might have even a plausible effect on land use, to the extent that runoff rates would increase and storm sewers would have to be lengthened or enlarged. These rates of flow were converted to equivalent numbers of storm sewers of several possible sizes. Baseline period expansions over existing storm sewer facilities, if any, were noted.

3.1.4.2 Proposed Action

Equivalent numbers of needed storm sewers were computed from Proposed Action population values which had been converted to newly developed acres of residential land. Differences in numbers of storm sewers were noted between baseline and project conditions.

3.1.5 Telephone Service

3.1.5.1 Baseline Future - No Action Alternative

For each ACS community, projections of growth and needed expansions of telephone equipment were taken from estimates by Mountain Bell, the Chugwater Telephone Company, or the United Telephone Company of the West, as appropriate.

3.1.5.2 Proposed Action

Differences between baseline future and project-induced telephone customer needs were noted. Particular attention was given to the needed additions of temporary telephones and transmission cable at F.E. Warren AFB during the early construction period. New Mountain Bell transmission cable needs there were noted.

3.2 Assumptions and Assumed Mitigations

3.2.1 Assumptions

Standard environmental engineering assumptions used widely in planning levels of analysis have been applied. The general ones of these are:

- o Facilities needs generally are direct functions of population growth. (Certain project-related activities, however, such as construction-period needs at a specific site, gave rise to solid waste and telephone needs not tied directly to population growth.)

- o Current or very recent unit factors of demand for utility services, such as gallons of water used per person per day, will remain constant throughout the planning period.

- o Impacts greater than negligible ones involve the need to build a new facility or to expand an old one, as opposed to an increase in the quantity of water to be pumped or garbage to be loaded into a truck. Changes in service levels for any utilities element requiring only changes in operational levels, such as the turning-up of a pump, were considered negligible, since the change could be made without adding equipment or manpower and since the added delivery costs could be easily recouped through charging for the slightly higher demand at the current rate.

Specific assumptions related to each utilities element are listed below.

3.2.1.1 Water Treatment and Distribution

- o Current unit factors of water demand, computed as daily deliveries of water divided by current population, will remain in effect in each community, even though they might be quite different from place to place. This is tantamount to assuming that a myriad of factors, such as price, standards of living, weather, cultural practices, condition of existing water mains, and others, determine the unit rate of demand in each place, and that an immigrant to each place will adapt by choice or by requirement to the practices and conditions of water use in his or her new community.

- o Water distribution system adequacy in the Cheyenne Urban Area could be determined precisely enough with steady-state simulations of maximum-day demand plus firefighting flows imposed on a skeletonized network of the existing pipes in both the Cheyenne Board of Public Utilities (CBPU) and the South Cheyenne Water & Sewer District (SCW&SD) systems.

3.2.1.2 Wastewater

o Current unit factors of waste generation in gallons per capita per day (gpcd) will not change. This assumption is related to the consistency of water use rates, assumed previously, and it was made for the same reasons.

o Simulation of skeletonized sewer networks in the Cheyenne Urban Area with peak-hourly flows for an average day would indicate sufficiently the adequacy of existing (major) sewers.

o Waste treatment plants will operate well (attain all discharge requirements for effluent quality) if they receive flows equal to or less than their design capacity; and they will operate sufficiently well if they receive peak-hourly flows on the average day not greater than two times the average flow.

o Pursuant to local plans now underway, the 201 Facilities Plan (Banner Associates, 1982) will be implemented between 1984 and 1987. Local and state officials are pursuing design and construction of Phase I of the Plan, the closing of South Cheyenne's plant with those wastes piped to the Crow Creek plant, in 1984. All design and construction activities for all phases of the Plan are anticipated locally, and assumed here, to be completed by the end of the 1987 construction season.

3.2.1.3 Solid Waste

o The unit waste generation rate in ACS communities will be near the national average of 5.0 pounds per person per day (which local data from some communities confirmed).

o The unit waste generation rate at F.E. Warren AFB will remain at the current unit rate of 2.76 pounds per resident per day.

o The assumed unit generation rate of 3.0 pounds per person per day for weekly commuters and transients will not change with time.

3.2.1.4 Stormwater

o The Rational Method (Q = CiA) for peak-storm runoff estimation can be applied to select needed storm sewers and appurtenances. (It is generally believed in hydrologic circles that the method is approximate. It remains, nonetheless, one of the most widely applied methods of urban runoff estimation, and it is considered appropriate for the planning-level analyses performed here to indicate whether new storm sewers would be required. Storm drainage facility design is highly site-specific; more detailed analyses at the local level will be needed when the time comes to design the additional facilities.)

o Rainfall records from only four of the cities in the Region of Influence and a regionally derived expression for rainfall intensity were sufficient to estimate rainfall quantities and intensities everywhere in the region.

3.2.1.5 Telephone Service

- Mountain Bell, the Chugwater Telephone Company, and United Telephone Company of the West can expand their local systems as necessary to accommodate new growth and will pass along necessary costs to the appropriate customers.

3.2.2 Assumed Mitigations

The impacts identified later herein can all be mitigated by any one of a variety of means. No specific, singular mitigation method has been assumed. Choice of actual mitigation measures to be adopted remains a matter of local prerogatives and negotiation among parties concerned. Nonetheless, the options that can be assumed for mitigating utilities impacts are these:

- Local agencies will expand equipment, facilities, and manpower as required and pass costs to appropriate consumers.

- The U.S. Air Force will purchase capacity or capacity expansions as necessary from local agencies or utility companies for direct project requirements.

- Local agencies will plan for, and install, facilities expansions required already or under baseline growth conditions. When those facilities are expanded, it is possible that project-induced increases in service demands will impact the new facilities negligibly or not at all.

3.3 Level of Impact Definitions

Impacts in utilities elements are directly related to increased service populations and population-induced land development and to specific project-related construction activities. The levels of impact can be defined generally for all elements as follows:

- Negligible Impact - Will have little or no noticeable effect on operating agency practices and will result in no noticeable change in service delivery among service customers. Will require no additional equipment or facilities. Any operational changes to increase output slightly could be effected by existing staff, and any increased resource costs could be recovered by charging for the added increment of demand at current rates.

- Low Impact - Will cause temporary degradations of service or performance such that operating agencies will have to change operating practices, increase staffs, or add equipment to return to satisfactory levels of performance and service delivery. Slightly higher service rates for all consumers or specific charges to limited customers for unique service alterations would likely be required.

- Moderate Impact - Will cause isolated failures or protracted overloads to existing facilities such that operating agencies will have to add or expand facilities, as well as having to add equipment or staff personnel.

- High Impact - Will cause major disruptions of service and degradation of existing performance characteristics, requiring major new facilities, equipment, personnel, and operational practices. Very noticeable rate increases or large specific charges to limited customers would be required.

An elaboration for each element of utilities is given below.

3.3.1 Water Treatment and Distribution

Communitywide water demands will increase with increasing service populations. Very small project-induced percentages of population growth could be accommodated by a water agency through mere increases in rates of use of existing filtration units or pumping facilities. These impacts would be considered negligible, because no new facilities or personnel would be required and because the added energy costs, if any, could be recouped by customer payments for the additional water at existing rates.

If population growth induced by the project required public water mains to be extended to new subdivisions, for example, such increased water demands and the necessary supply facilities would be considered a low impact.

If the project induced enough growth to exhaust the available capacity of a water supply source such that some new wells would have to be drilled and existing water treatment would have to be expanded, a moderate impact would be realized. Almost assuredly, the rates for water service would increase for all customers, unless circumstances permitted the new population to be identifiably isolated on only the new water system, in which case the new customers could be charged at an appropriate rate to recover the full capital and operating costs of the addition.

Substantial changes in demand requiring entirely new storage reservoirs, treatment plants, wellfields, or communitywide distribution systems resulting from project-induced growth would be ranked as a high impact. Completely new charge schedules would have to be adopted. Moreover, there would likely be a protracted period of substandard service while the appreciable reconstruction was completed.

3.3.2 Wastewater

Negligible wastewater impacts would ensue if wastewater flows could all be contained within existing sewers and only operational changes such as increased aeration were required at treatment plants. Even though there may be increased costs associated with such small impacts, such as the energy cost for pumping additional air, these costs could be recovered through charges to the new customers at existing unit rates ($/1,000 gal).

If new public interceptor sewers had to be built into new development areas, if existing sewers in local areas had to be enlarged, or if another treatment unit at an existing plant had to be constructed to avoid discharge violations, these would constitute low impacts. Charges might have to be increased to recover the added costs.

If whole systems of sewers had to be rebuilt at larger sizes, or if a new treatment process had to be added to an existing treatment plant, these would constitute moderate impacts.

If a communitywide sewer system had to be rebuilt or a whole new town or community-level subdivision had to be sewered, or if a doubling or tripling of waste treatment capacity had to be added, these would be high impacts. Entirely new and noticeably higher service charges would have to be adopted. Additionally, disruptions of the community and protracted periods of degraded service would occur during the period of major reconstruction.

3.3.3 Solid Waste

Project-induced growth so small that existing collection crews could load the resulting garbage onto existing trucks without working additional hours would constitute a negligible impact.

If existing crews were required to work more hours, or if existing frequencies of garbage collection had to be lengthened, or if new disposal areas had to be developed and used during the project period, or if dates for purchase of needed equipment in the baseline period had to be accelerated for the project, these would be low impacts.

If additional collection equipment (trucks) or new disposal-site compactors or excavating equipment had to be purchased to accommodate the project, beyond baseline needs, these would constitute moderate impacts. A requirement for the purchase of new disposal areas not needed in the baseline period would also be a moderate impact.

New collection trucks and crews to work entirely new routes, plus new disposal-site equipment and crews and the purchase of new disposal areas would collectively constitute a high impact.

3.3.4 Stormwater

Negligible impacts would occur if storm runoff rates were not increased over existing levels, or if runoff increases that did occur were drained through the local area without flooding and were detained sufficiently to avoid increased flood flows downstream, or if runoff increased but by so little that no new storm sewers or detention facilities would be required.

Low stormwater impacts would occur if project-induced growth required enough development of new lands that even one storm sewer would be required but without detention to avoid added downstream flooding.

Moderate impacts would occur if major new storm sewers were required for upstream, fringe-area development to absorb the project-induced growth, and detention storage were not required to protect against increased flooding damage in downstream areas along receiving waters.

High impacts would occur if growth induced by the project were so extensive that some local flooding and major increases in downstream flooding would then be assured, despite major construction of new storm sewer facilities to protect the upstream affected community.

3.3.5 Telephone Service

Impacts related to telephone service are slightly different from the others, since private utilities rather than public agencies would be affected and would have to respond to the mitigations. Nonetheless, similarities are obvious as well.

Negligible impacts would occur if current installation, maintenance, and exchange personnel could install and operate project-induced telephone equipment and recover costs through existing rate structures.

Low impacts would result if telephone companies had to hire any new personnel or to install special pieces of project-related equipment.

Moderate impacts would result if project-induced telephone demands required expansions in service capability such that local telephone rates would have to be increased as a result of upgrading of general transmission or exchange equipment.

High impacts would result from project-induced requirements for major communitywide system modifications or from special requirements for extensive or numerous telephone cable relocations or installations of special equipment in the field, the costs for which could not be recovered through normal rate structures for telephone usage.

3.4 Significance Determination

Significance is a qualitative measure of the features or contexts of an impact, in addition to its size or level. If one or more of the following conditions exists, an impact, regardless of its level, may be considered significant:

- The impact worsens, either slightly or considerably, a preexisting deteriorated environmental condition or overloads an already inadequate facility.

- The impact affects public health or safety.

- The impact is likely to be highly controversial.

- The impact is highly uncertain or involves unique or unknown risks.

- The project-induced result and its impact are related to other project-induced results with individually unimportant but cumulatively important impacts.

- The project-induced result or its impact threatens the violation of some federal, state, or local law or regulations imposed for the protection of the environment.

- Extensive institutional responses to the impact would be necessary (e.g., if a wastewater agency would have to commit to a major or unusual planning or reprogramming project to ameliorate the induced impacts).

3.5 Environmental Consequences of the Proposed Action and the No Action Alternative

3.5.1 Water Treatment and Distribution

3.5.1.1 Baseline Future - No Action Alternative

3.5.1.1.1 Cheyenne Urban Area

3.5.1.1.1.1 Water Treatment

It is anticipated that by 1992 the Cheyenne Urban Area service population will be 69,721, which includes F.E. Warren AFB and the SCW&SD. The average-day water use is projected to be 15.60 million gallons per day (mgd). The recurring maximal day water use is forecast to be 35.88 mgd. Water use at F.E. Warren AFB is not expected to increase above 1983 levels.

It is projected that by 1992 on an average day, the CBPU will supply to 0.86 mgd to the SCW&SD, and during a typical maximum day the rate will be 1.45 mgd. The service population of the SCW&SD is expected to be 7,510 by 1992.

The existing CBPU surface water treatment facilities and wells can supply 32 mgd to the distribution system based on the following conservative rating system.

o	Round Top	7 mgd
o	Happy Jack	19 mgd
o	Wellfield	6 mgd

Therefore, a shortfall of almost 4 mgd in treated water delivery capacity (excluding supply from available storage) would occur in 1992. As indicated previously, it may be possible to make up this shortfall with additional, feasible groundwater pumpage, as was done in 1983 when an extreme peak-day demand in July required 33.5 mgd.

3.5.1.1.1.2 Water Distribution

The CBPU distribution system was analyzed for the same maximum day plus fire flow event discussed under the baseline description, but with a 1992 baseline service demand imposed. In general, the various demands caused the system water pressures to be reduced from 1983 levels (Table 2.6.1-2) by 3 to 18 pounds per square inch (psi), as indicated in Table 3.5.1-1. The contributing 436,700 gallons per hour (gph) supply rate of water from the Buffalo Ridge tank nearly doubled above the 1983 levels to satisfy additional service demands from baseline growth to the east and north of the existing city limits. The Frontier Mall fire event still imposed the most extreme demands on the water distribution system when compared to the other nodes and neighborhoods. The residual pressures at the two hydrants supplying 4,860 gallons per minute (gpm) were reduced to 11 and 14 psi. This fire event imposed a withdrawal rate of 436,700 gph on the Buffalo Ridge tank, a flow that could be sustained for 6 hours if the tank were at least half full.

Table 3.5.1-1

BASELINE WATER DEMANDS AND PRESSURES AT SELECTED WATSIM NODES IN CHEYENNE NEIGHBORHOODS (1992 MAXIMUM DAY PLUS FIRE-FLOW EVENT)

Neighborhood and No.	WATSIM Node No.	Nodal Water Demand, mgd	Nodal Water Pressure, psi
Dildine	124	.47	87
8	127	.49	93
	341	.69	112
	342	.51	104
	343	.19	109
Frontier Mall	360	.58	95
12	361	.49	98
	362	.98	90
	71	4.0	14
	73	3.0	11
Grand View	147	.76	108
16	382	.79	93
North Ranchettes	391	.44	54
26			
Yellowstone	396	.34	78
34	69	.27	75
	68	.27	85

The SCW&SD distribution system was analyzed for the same maximum day plus fire flow event discussed under the baseline description, but with a 1992 baseline service demand. The projected baseline growth was allocated to currently planned and approved residential developments, and the new water demands were added to the distribution system as shown in Figure 3.5.1-1. The resulting flows and pressures for a maximum-day demand and a fire event are given in Table 3.5.1-2.

As can be seen from the table, pressures will continue to drop at virtually all nodes as the water demands increase throughout the period from 1983 to 1992. Indeed by 1990 the water pressure at the test fire hydrant would be below 20 psi, and the water pressure for new developments at the south end of the community (at node 663 - see Figure 3.5.1-1) would be only 10 psi. In the 1992 case, the fire flow had to be dropped from 450 gpm (0.65 mgd) to 375 gpm (0.54 mgd) at node 662, or no water pressure at all would remain to supply the proposed South Fork and Lone Tree developments. These pressures would be inadequate, and bolstering improvements to the distribution system, such as the Division Avenue 8-inch water main extension shown in Figure 3.5.1-1, will have to be made to accommodate new growth.

3.5.1.1.2 All Other Communities

3.5.1.1.2.1 Chugwater, Wyoming

Chugwater's population is expected to grow from 230 to 310 by 1992. At 391 gpcd, the new daily water demand will be 0.121 mgd, less than a third of available capacity (0.439 mgd). No new water distribution facilities should be necessary. It should be mentioned, however, that the water supply is currently repumped in town from a pumphouse that brings water pressure at that point up to 60 to 68 psi. As demands increase throughout the town, it will become more difficult to maintain pressures everywhere in the system at comfortable, expectable pressures (above 40 psi). Eventually additional booster pumping or elevated storage at other points in the distribution system may become necessary.

3.5.1.1.2.2 Gering, Nebraska

Projections reveal that population in Gering will rise steadily to 11,180 in 1992, an increase of 2,620 people over today's level. As described earlier, the Gering system has excess capacity for 2,155 people. Therefore, rehabilitation of the extra 1.0-mgd well now on hand will be needed.

3.5.1.1.2.3 Kimball, Nebraska

Kimball's population has been projected to increase by 80 people (from 3,140 to 3,220) by 1992. Since this represents about 29 households or customers, pumping would have to be increased by 678,600 gallons per month (29 homes x 23,400 gal/mo-home). The added revenue to the City would be $480 per month (29 x $16.54), or $5,760 per year. However, the City would have added pumping energy costs equal to $30.12 per month or $361.44 per year. (These computations assume a 200-foot pumping lift which may be high, and a $0.06 cost per killowatt-hour). The net revenue to the City, then, will be about $450 ($480-$30.12) per month or about $5,400 ($5,760-$361.44) per year.

No noticeable operations or facilities changes will be necessary.

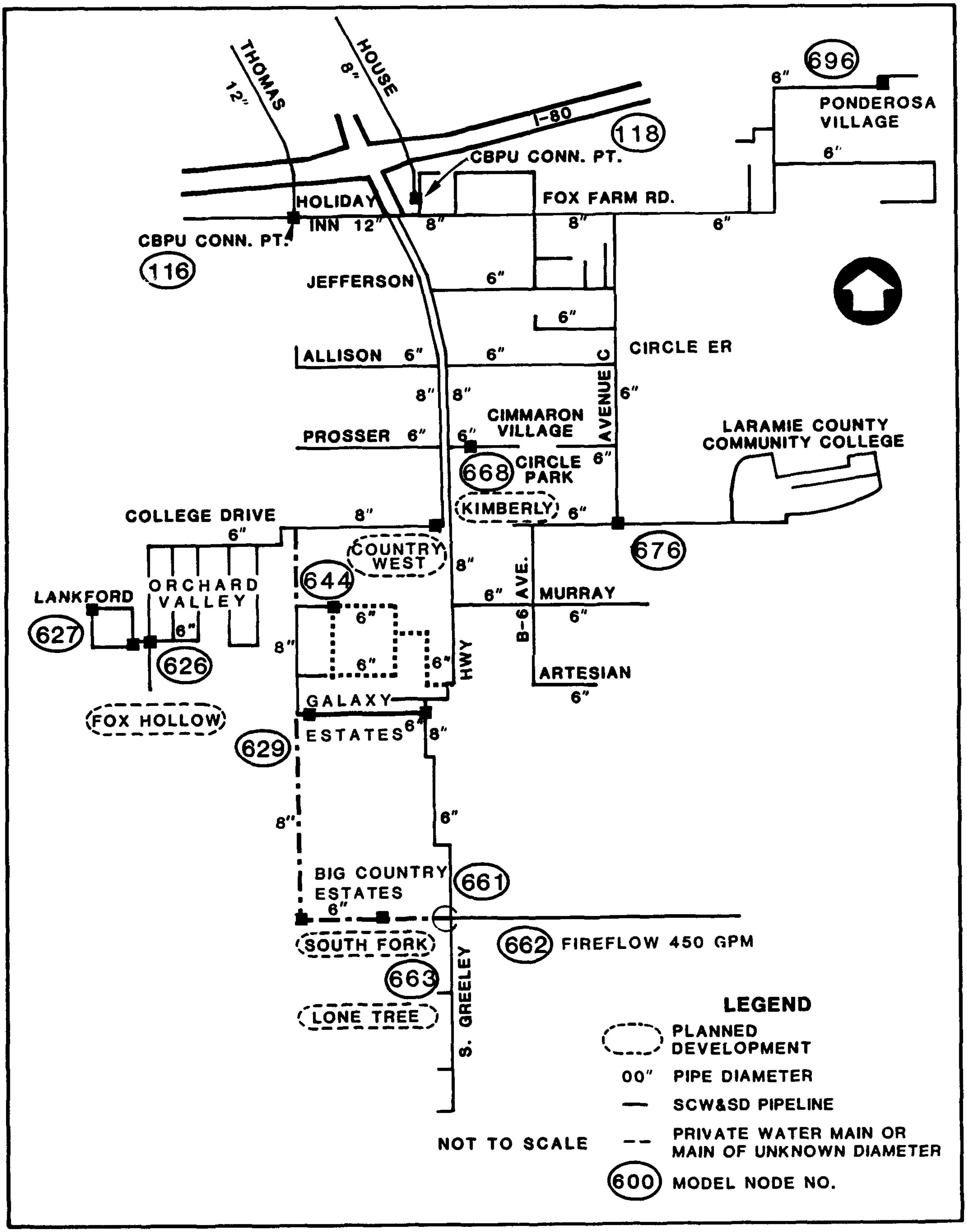


FIGURE 3.5.1-1 POTENTIAL EXPANDED DISTRIBUTION SYSTEM IN THE SOUTH CHEYENNE WATER AND SEWER DISTRICT

Table 3.5.1-2

BASELINE WATER DEMANDS AND PRESSURES AT SELECTED WATSIM NODES IN THE SCW&SD (1992 MAXIMUM DAY PLUS FIRE-FLOW EVENT)

Demand Point Description	WATSIM Node No.	Nodal Water Demand, mdg		Nodal Water Pressure, psi
CBPU Connection	116	1.49		77
CBPU Connection	118	.49		89
Ponderosa Village	696	.02		125
Continental[1]	615	.03		104
Fox Hollow[2]	626	.01		93
Lankford	627	.01		83
Galaxy Estates	629	.07		59
Country West	644	.03		55
Big Country Estates	661	.11		28
Fire Hydrant	662	.54	(375 gpm)[3]	13
South Fork and Lone Tree[2]	663	.10		16
Kimberly[2]	668	.02		99

Notes: 1 Expansion of existing mobile home park.
2 New development.
3 Reduced from 450 gpm.

3.5.1.1.2.4 Pine Bluffs, Wyoming

The population growth of 128 people by 1992 represents an 11.4 percent increase in population over today's level. With current pressures being adequate and newly acquired water rights, the current system of water supply appears adequate to absorb the modest growth without expansion.

3.5.1.1.2.5 Scottsbluff, Nebraska

Projections reveal very little change (700 people) for Scottsbluff's population during the period 1983 to 1992. Thus, no further additions to water treatment and distribution facilities are necessary. The water system is adequate for the current population plus 7,140 more people on a peak-day demand basis.

3.5.1.1.2.6 Torrington, Wyoming

The 10 producing wells have maximum capacity of about 10,500 gpm or 15 mgd. On a sustained basis, they could operate at only about half that capacity or 7.5 mgd. By 1992, when the population has been projected to grow to 6,970, the peak-daily demand should be only 4.3 mgd (6,970 x 250 gpcd x 2.5 peaking factor). Hence, excess capacity will be available throughout the baseline period.

3.5.1.1.2.7 Wheatland, Wyoming

Without the project, the town of Wheatland has excess water capacity for approximately 2,700 people. This is based on the following assumptions: peak demand is 2.16 mgd, and the maximum capacity is 8 wells pumping at 450 gpm each for 16 hours per day. Since the population projections for the baseline period (1983 to 1992) indicate growth of only 1,070 people, expansion of the water supply will not be necessary. The current program to replace 2-inch lines in the distribution system should provide sufficient upgrading of this system.

3.5.1.2 Proposed Action

3.5.1.2.1 Cheyenne Urban Area

3.5.1.2.1.1 Water Treatment

Project-related immigration to the Cheyenne Urban Area will reach its peak in 1987 (2,650 people), after which the differences between baseline and project-condition populations will begin to decline. The difference will be 1,199 by 1990 and only 906 by 1992. Maximum-day water demands in 1987 will be 33.23 mgd with the project, compared to 32.20 mgd without the project, a difference of 1.03 mgd. By 1990 the maximum-day demands with the project will have grown to 34.95 mgd, as compared with 34.50 mgd in the baseline case, a difference of only 0.44 mgd. By 1992 the project-condition demand will be 36.03 mgd compared with 35.88 mgd in the baseline scenario, a difference of merely 0.15 mgd. (Precision considerations, of course, make it clear that these differences will actually be undetectable.)

As noted previously, the sustainable rate of treated water delivery capacity is 31 mgd, with the possibility of delivery of 35 mgd through peak-month

pumping of the wellfields at 9 mgd instead of 6 without accelerated usage of stored treated water (22 million gallons [MG] available). The project will cause the maximum-day demand to attain almost the full capacity (35 mgd) in 1990, when the demand will be 34.94 mgd (versus 34.50 mgd in the baseline case). The project will cause attainment of a 36-mgd demand by 1992 (demand = 36.03 mgd) versus 35.88 mgd in 1992 in the baseline scenario.

The maximum-day differences between the baseline and the project cases are never very large (3.2 percent larger in 1987 when capacity will still be adequate). By 1992, when available treated-water delivery capacity (35 mgd) will be exceeded both by baseline and project conditions, the project's increase to maximum-day demands will be only 0.4 percent (0.15/35.88). Therefore, the project will not cause the exceedances of available capacity; they will result in the baseline case as well, and in the same years. However, if additional treatment capacity or groundwater supply capacity is not provided by 1990, the project will contribute in a negligible way to exacerbation of an existing shortfall in capacity and add somewhat to the necessity to operate the water supply system by filling and withdrawing from the 22 million gallons (MG) of available storage at more rapid rates than is currently the practice to meet maximum-day demands. This finding is conditioned by the assumptions that 1) baseline growth will be as rapid as projected in this study and 2) that short-period conservation to reduce demands would not be practiced. Indeed curtailment of lawn watering during high demand periods of maximum days could substantially reduce demands and keep them within available supply capacity.

3.5.1.2.1.2 Water Distribution

General System. The distribution systems in both the CBPU and SCW&SD service areas were analyzed for 1987 and 1990 maximum-day demand conditions with the project in place, plus fire flows. The most notable change occurred in 1987, when the Buffalo Ridge tank drain rate increased from 353,300 gph without the project to 374,600 gph with the project. The difference represents 6.7 hours versus 7.1 hours of available storage in the tank to fight the simulated fire.

1987 Maximum-Day Demand Plus Fire Flow at Frontier Mall. The projected 1987 typical maximum-day water demand is 33.23 mgd. The differences in pressures and flows at the selected nodes between baseline and project conditions are given in Table 3.5.1-3.

It can be seen that while demands at various nodes will be higher with the project than without it, the pressures will deteriorate only slightly, roughly between 1 and 2 psi, a change that will be undetectable by baseline users.

1990 Maximum-Day Demand Plus a Fire Flow at Frontier Mall. The projected 1990 typical maximum-day water demand is 34.94 mgd. The differences in pressures and flows at the selected nodes between baseline and project conditions are given in Table 3.5.1-4. Most flows are identical between the two conditions, and most of the pressures are unchanged as well. (It was at the point this became obvious that the decision was made to forego the 1992 simulation of project conditions, since the population and demand differences from the baseline were even smaller than in 1990 and the pressure differences would have been indistinguishable.)

Table 3.5.1-3

WATER DEMANDS AND PRESSURES AT SELECTED WATSIM NODES IN CHEYENNE NEIGHBORHOODS (1987 MAXIMUM DAY PLUS FIRE-FLOW EVENT)

Neighborhood	WATSIM Node No.	Baseline Demand and Pressure at Node		Project Demand and Pressure at Node	
Dildine	124	0.45 mgd @	96 psi	0.46 mgd @	93 psi
(8)	127	0.13	103	0.29	101
	341	0.67	121.5	0.67	119
	342	0.30	115	0.30	112
	343	0.17	119	0.17	117
Frontier Mall	360	0.56	99	0.56	98
(12)	361	0.47	102	0.47	101
	362	0.33	93		
	363			0.26	92
	364			0.26	83
	71	4.0	16	4.0	15
	73	3.0	13	3.0	13
Grand View	147	0.74	114	0.74	112
(16)	382	0.28	104	0.43	102
North Ranchettes (26)	391	0.17	57	0.23	56
Yellowstone	396	0.21	79	0.25	79
(34)	69	0.25	77	0.25	75.5
	68	0.25	86	0.25	86

Table 3.5.1-4

WATER DEMANDS AND PRESSURES AT SELECTED WATSIM NODES IN CHEYENNE NEIGHBORHOOD (1990 MAXIMUM DAY PLUS FIRE-FLOW EVENT)

Neighborhood	WATSIM Node No.	Baseline Demand and Pressure at Node		Project Demand and Pressure at Node	
Dildine	124	0.46 mgd @	90 psi	0.46 mgd @	90 psi
(8)	127	0.40	97	0.47	97
	341	0.58	115	0.68	115
	342	0.42	108	0.42	108
	343	0.18	113	0.18	113
Frontier Mall	360	0.57	96	0.57	96
(12)	361	0.48	99	0.48	99
	362	0.79	91		
	363			0.43	91
	364			0.44	82
	71	4.0	14.5	4.0	14
	73	3.0	12.1	3.0	12
Grand View	147	0.75	110	0.75	110
(16)	382	0.61	97.5	0.67	97
North Ranchettes	391	0.31	55	0.40	55
(26)					
Yellowstone	396	0.30	78	0.32	78
(34)	69	0.26	75	0.26	80
	68	0.26	86	0.26	86

The difference in drain rates from the Buffalo Ridge tank in 1990 with and without the project will be 413,000 versus 412,500 gph, respectively, a 6.05-hour event versus a 6.06-hour event.

SCW&SD 1987 and 1990 Maximum-Day Demands Plus Fire Flows. Because the water distribution system in South Cheyenne as shown in Figure 2.6.1-3 is inadequate to accommodate baseline growth already anticipated, the bolstered distribution network shown in Figure 3.5.1-1 has been assumed to be in place by 1987. A comparison of the baseline and project conditions is given in Table 3.5.1-5. The 1987 water service population with the project has been estimated to be 7,331 versus 6,740 without the project. For 1990, the estimated water service population with the project will be 7,489 versus 7,190 without it. Still, as the table shows, while water demands would be increased with the project, water pressures would at the same time be markedly improved by only the few water main extensions shown in Figure 3.5.1-1. The fireflow of 450 gpm, for instance, could be supplied in 1990 at 62 psi pressure, while at the same time the South Fork and Lone Tree developments could be supplied at 0.1 mgd and 66 psi, rather than only 0.04 mgd and an inadequate 10 psi, as in the baseline scenario (without the anticipated water main improvements).

If the improvements shown in Figure 3.5.1-1 are instituted during the early part of the baseline period, i.e., prior to 1987, to improve the system as existing problems and anticipated growth require, there will be no adverse water distribution impacts in South Cheyenne.

Cheyenne Board of Public Utilities Staff Requirements. During the comment period on the draft report, the Air Force was asked for an analysis of the current staff of the Board of Public Utilities and how the Peacekeeper project might impact staff reqiurements. The Board provided a list of current staff positions, which is reproduced as Table 3.5.1-6.

As has been analyzed and reported previously, neither water nor waste treatment plants will have to be enlarged to accommodate the project inmigrants. The flows through these facilities will increase somewhat (less than 4 percent in the peak year of 1987), but these increases can be monitored without a change in personnel.

The customer-related services of meter-reading, customer accounting, and providing of new customer tap-ins to water mains and sewers have been analyzed. To justify a new position for these three subareas of the Board's work, increases in the workload over baseline conditions would have to be enough to require a new full-time employee. Currently there are 5 meter-reading and 6 customer-accounting employees, and 6 utility crews (crew chiefs) to make new-customer tap-ins to water mains and sewers among these crews' myriad other duties.

Table 3.5.1-7 presents an analysis of the workloads of these personnel in 1983 and in 1987 both with and without the project. The 5 meter-reading and 6 customer-accounting personnel now handle nearly 18,000 customers, and their workload would have to increase between 16.7 percent (1/6) and 20.0 percent (1/5) to justify a new position. By 1987 with the project, the workload will have increased by 11.8 percent (compared with 7.6 percent under baseline conditions). No new full-time employees are warranted.

Table 3.5.1-5

PROJECT-RELATED AND BASELINE WATER DEMANDS AND PRESSURES
AS SIMULATED WITH THE WATSIM MODEL
FOR SOUTH CHEYENNE

Development or Site	Model Node No.	Water Demands and Pressures as Modeled							
		Baseline Conditions				Project Conditions			
		1987		1990		1987[a]		1990[a]	
CBPU Connection	116	1.45 mgd	@ 78 psi	1.51 mgd	@ 76 psi	1.58 mgd	@ 76 psi	1.58 mgd	@ 76 psi
CBPU Connection	118	0.49	91	0.51	89	0.53	89	0.53	89
Ponderosa Village	696	0.02	128	0.02	126	0.02	127	0.02	126
Continental	615	0.01	107	0.03	104	0.03	92	0.03	92
Fox Hollow	626					0.01	77	0.03	77
Lankford	627	0.01	86	0.01	83	0.01	66.5	0.01	66
Galaxy Estates	629	0.07	70	0.07	64	0.07	75	0.07	75
Country West	644	0.02	74	0.03	69	0.03	81	0.03	83
Big Country Estates	661	0.11	35	0.11	26	0.11	71	0.11	70
Fire Hydrant, U.S. 85	662	0.65	21.8	0.65	12	0.65	63	0.65	62
S. Fork/Lone Tree	663			0.04	10	0.10	66	0.10	66
Kimberly	668					0.02	107	0.02	109

Note: a With Division Avenue 8-inch water main extension in place.

Table 3.5.1-6

STAFF POSTIONS OF THE
CHEYENNE BOARD OF PUBLIC UTILITIES

Administration	Accounting	Engineering	Water and Waste Treatment	Support
Director(1)	Accountant(1)	Mgr.(1)	Wat. Mgr.(1)	O&M Mgr.(1)
Asst. Dir.(1)	Data Proc. Sup.(1)	Consultant(1)	Waste Mgr.(1)	Support Services Sup.(1)
Office Mgr.(1)	Programmer(1)	Construction Inspector II(1)	Chief Plant Operator(4)	Oper. Acct.(1)
Admin. Secy.(1)	Compu.Oper.(1)	Construction Inspector I(1)	Pl. Oper. IV(8)	Dispatch. Tech.(1)
	Data Entry Clk.(1)	Drafter(1)	Pl. Oper. III(5)	Inventory Clk.(1)
	Cust. Acct. Sup. (1)		Pl. Oper. II(5)	Secy.(1)
	Cust. Acct. Sen. Clk.(1)		Pl. Oper. I(1)	Mechanic II(2)
	Cust. Acct. Bill Clk.(2)		Pl. Oper.- New Hire(1)	Util. Foreman(2)
	Cust. Acct. Cashier(2)		Lab. Tech.(1)	Util. Crew Chief(6)
	Meter Inspector & Collector(1)			Util. Worker III(6)
	Meter Reading Sup.(1)			Util. Worker II(5)
	Sen. Met. Read.(1)			Util. Worker I(3)
	Meter Reader(3)			Cust. Serv. Tech.(2)
				Meter Main. Tech.(2)
				Safety Serv. Tech.(1)
				General Clk.(1)

Total Positions = 89

Table 3.5.1-7

ANALYSIS OF STAFF REQUIREMENTS FOR CERTAIN FUNCTIONS OF THE CHEYENNE BOARD OF PUBLIC UTILITIES

	Customer Related Functions		
Item	Meter Reading	Utility-Crew Tap-Ins	Maintenance of Customer Accounts
Current Customers or Tap-Ins/Yr	17,845	190	17,845
Current Positions or Crews Required	5P[1]	0.5C[2]	6P
1987 Customers or Tap-Ins/Yr	19,204	495	19,204
Baseline % Increase in Workload	7.6	260	7.6
1987 Positions or Crews Required	5P	1.3C	6P
PROJECT CONDITIONS			
1987 Customers or Tap-Ins/Yr	19,949	628[a]	19,949
Project-Period % Increase in Workload over 1983	11.8	331	11.8
1987 Positions or Crews Required	5P	1.65C	6P
Induced Position or Crew Changes	0P	0.35C	0P
New Full-Time Employees Required by the Project	0	1	0

Notes: 1 P = Positions = 1 Full-time Employee.

2 C = Crews = 20 Utility Workers/6 Crew Chiefs = 3.3 FTEs/Crew.

a 628 - 495 = 133 = Net Housing Demand in <u>1986</u>, which is the peak net housing-demand year (not 1987).

In 1983, new tap-ins are being made at the rate of roughly 190 per year. If a utility crew can perform 2 of these per day, roughly one-half crew (out of six) is working on these duties all the time. By 1987 in the baseline case, population projections reveal that there will be 495 tap-ins to be made each year. This will require 1.3 crews working full time. With the project, the net housing demand will be 133 new homes, actually occurring in 1986. (There will only be 40 new homes required in 1987.) But the 133 new tap-ins will bring the total workload to 628 tap-ins, an increase of 1.65 full-time crews. The difference between project and baseline crews required will be 0.35 (1.65-1.3).

Apparently, a crew today comprises 3.33 people on the average (20 utility workers/6 crew chiefs). The net project requirement, then, is 1 crew member (0.35 x 3.33), a negligible and insignificant impact, given the added revenue of $218,250 the Board will receive for the effort (133 taps @ $1,641).

3.5.1.2.2 All Other Communities

3.5.1.2.2.1 Chugwater, Wyoming

The expected project immigration of 50 people between 1985 and 1987 will increase water demands by 0.02 mgd on an average day and perhaps by as much as 0.06 mgd on a peak-demand day. Baseline usage in the same period will be between 0.098 and 0.106 mgd. Capacity in place will still be 0.439 mgd. No adverse impacts on the water distribution system can be anticipated.

If the 50 people expected to be added to Chugwater represent 20 new homes (water customers), the added revenue to the City will be $5,000 in tap-in fees, plus $1,560 per year (for 3 years) in water service fees. Water distribution costs per customer are not known.

3.5.1.2.2.2 Gering, Nebraska

In 1987, 116 people are projected to be the immigrants induced by the project. This is the maximum immigration expected. Water demands in the peak year will increase over the baseline condition by 1.16 percent (116/9,970). Other-year increases over baseline will be proportionately less. Accordingly, no water supply facilities impacts can be anticipated.

3.5.1.2.2.3 Kimball, Nebraska

The 300 net immigrants in 1989 will bring the peak population to 3,490; this is 350 more than in 1983.

The 350 new residents or about 127 households will demand 2,971,800 gallons (127 x 23,400) of additional water each month over today's demand. This also represents a 9.0-percent (300/3,340) increase over baseline demands (including the 150 people served outside the city) in 1989 and a 10.6 percent (350/3,290) increase over today's demands. No new facilities would be required. Only an operational change to increase pumping rates by 10.6 percent over today's pumpage would be necessary. (Recall that excess capacity exists for 424 people, compared with the peak addition over today's population of 350.)

3.5.1.2.2.4 Pine Bluffs, Wyoming

The presence of a maximum of 150 additional people in Pine Bluffs would increase the average-day water demand by 74,700 gallons per day and the peak-day demand by 190,650 gallons per day. These values are based on the current average-day per capita demand of 498 gpcd and a peak-day per capita demand of 1,271 gpcd. No impact on water supply facilities can be anticipated from this increase in flow, which is only 17 percent higher than the growth expected during the baseline period.

3.5.1.2.2.5 Scottsbluff, Nebraska

Projections reveal that 234 immigrants would move to Scottsbluff in 1988, the peak year in which project-induced populations are expected to arrive. The maximum influx of 234 people would increase average-day water demands from the present 4.0 mgd to 4.065 mgd (4 mgd + 234 people x 277 gpcd). Peak-day demands could be increased by 194,500 gallons, or from the current 12.0 mgd to 12.195 mgd. These added flows could be accommodated with little or no adjustment to today's pumping rates. Resulting changes in distribution system pressure should not be measurable.

3.5.1.2.2.6 Torrington, Wyoming

The 255 projected peak immigrant population in 1987 will increase average-day demands by 56,250 gallons per day over the 1.52 mgd average rate under baseline conditions for that year. In other words, demands will be 0.056 mgd or 3.7 percent higher with the project in the peak years than in baseline. With 7.5 mgd capacity available, no new pumping facilities will be required.

It has been assumed that the necessary additions to water storage (1.52 MG - 0.35 MG existing) will be made prior to 1987. In that case, adequate storage for firefighting purposes will be available.

In summary, no project-induced water treatment or distribution impacts are foreseen.

3.5.1.2.2.7 Wheatland, Wyoming

The presence of a maximum of 450 additional persons in Wheatland will increase the average-day demand by 162,000 gallons and the peak-day demand by 216,000 gallons. These demands represent a 10-percent increase over the current water demand. No further water distribution facilities will be necessary.

3.5.2 Wastewater

3.5.2.1 Baseline Future - No Action Alternative

3.5.2.1.1 Cheyenne Urban Area

3.5.2.1.1.1 Sanitary Sewers

Computer simulations of the sanitary sewer systems in the Crow Creek, Dry Creek and South Cheyenne basins were performed for baseline conditions in 1983, 1987 (peak project year), 1990, and 1992. The sewage inflow hydrographs

used in the model were computed from the populations shown in Tables 3.5.2-1, 3.5.2-2, and 3.5.2-3. These 24-hour hydrographs simulated the daily flow variations in the sewer system including peak-hour flows. Infiltration into the system was also modeled.

Hydrographs were calculated for the various subwatersheds making up the Crow Creek, Dry Creek, and South Cheyenne basins, and they were added to the modeled sewer networks as shown earlier in Figures 2.6.2-1 and 2.6.2-2.

The results of the SWMM modeling indicate that all pipes in the future baseline cases, except the 12-inch sewers serving F.E. Warren AFB, have adequate capacity to carry the simulated sewer flows. Because the population at F.E. Warren AFB does not change in any of the cases, the magnitude of the surcharging of the 12-inch pipes serving the AFB will not change. The location, size, and capacity of this 12-inch pipe section is shown in Table 3.5.2-4. Also included in the table is the amount of pipe that would need to be replaced, if replacement is the method chosen to solve the surcharging problem. The approximate planning cost of this replacement includes additional costs such as pavement repair, removal of old pipe, and manhole modification.

Note that replacement of one pipe section very nearly at capacity is also included in the estimate, although its replacement is not strictly required.

3.5.2.1.1.2 Treatment Plants

It has been assumed here that the 201 Plan's recommended improvements will be implemented in the very near future. This assumption is based on the current situation in which the combined capacities of the Crow Creek and Dry Creek plants are exceeded for several months each year. The combined capacity in place is 4.5 + 4.0 = 8.5 mgd. In the peak month, flows are 5.5 mgd at Crow Creek and 4 mgd at Dry Creek, a total of 9.5 mgd. The South Cheyenne plant, which is known to be overloaded at 0.67 mgd, has peak-month flows of 0.76 mgd.

Hence, all the treatment plants need immediate relief or expansion. Recent information supplied by both local and state officials indicates that design and implementation of the first phase of the Plan should commence in early 1984, remaining grant funds for state and federal cost sharing could be available by 1985, and all Plan features should be implemented by 1987.

Under baseline conditions, as shown in Table 3.5.2-5, the average flows generated in the 3 basins in 1987 (the peak project inmigration year) will be 4.70 mgd, 3.77 mgd, and 0.72 mgd at Crow Creek, Dry Creek, and South Cheyenne, respectively. The total waste generation, therefore, will be 9.19 mgd, just above the average-day capacity of 9.1 mgd at the 3 plants (4.5 + 4.0 + 0.6). By 1992, the end of the baseline period, the average flows will have increased to 9.34 mgd at the Crow and Dry Creek plants combined and 0.80 mgd at South Cheyenne, a total of 10.14 mgd. This is further in excess over available capacity (9.1 mgd).

However, the average daily flows in the peak month (or 2) will have grown by 1987 to 10.17 mgd at the 2 main plants, in excess of available capacity today (8.5 mgd). By 1992 the excess at the 2 plants in the peak month(s) will be 2.72 mgd (11.22 mgd - 8.5 mgd). Perhaps most importantly, the peak-month

Table 3.5.2-1

BASELINE POPULATIONS ALLOCATED TO CROW CREEK SEWER SYSTEM MODEL NODES

Model Node No.	Baseline Populations 1983	1987	1990	1992
1	1,695	1,695	1,695	1,695
2	698	698	698	698
3	685	685	685	685
4	2,025	2,025	2,025	2,025
5	569	569	569	569
6	1,122	1,122	1,122	1,122
7	1,783	1,835	1,882	1,916
8	386	386	386	386
9	633	633	633	633
10	1,588	1,588	1,588	1,588
11	2,232	2,302	2,369	2,407
12	1,187	1,256	1,323	1,361
13	929	929	929	929
14	513	514	513	513
15	794	794	794	794
16	794	794	794	794
17	2,478	2,478	2,478	2,478
18	650	650	650	650
19	1,886	1,886	1,886	1,886
20	2,814	2,847	2,879	2,895
21	1,541	1,541	1,541	1,541
22	101	101	101	101
23[a]	3,000	3,000	3,000	3,000
24[a]	1,500	1,500	1,500	1,500
25[a]	1,500	1,500	1,500	1,500
TOTALS[a]	30,733	30,958	31,170	31,296

Notes: 1 *Model nodes were shown in Figure 2.6.2-1.*

a F.E. Warren AFB was modeled as though its population were 6,000 instead of the actual 3,630, to account for abnormal infiltration/inflow which occurs there. (Average outflow = 0.9 mgd.) Actual peak outflow from the base was computed as:

$$2.84 \text{ cfs} = \frac{6{,}000\ (120\ \text{gpcd})(2.3\ \text{peaking factor}) + 6{,}000\ (150\text{-}120)}{(646{,}317\ \text{gallons per day})/1\ \text{cfs}}$$

Table 3.5.2-2

BASELINE POPULATIONS ALLOCATED TO DRY CREEK SEWER SYSTEM MODEL NODES

Model Node No.[1]	Baseline Populations 1983	1987	1990	1992
1	1,024	1,676	2,369	2,846
2	905	970	1,026	1,066
3	3,242	4,070	4,824	5,350
4	708	708	708	708
5	1,735	1,990	2,225	2,386
6	958	1,213	1,448	1,609
7	1,635	2,166	2,604	2,941
8	423	533	636	707
9	3,569	3,753	3,966	4,088
10	540	540	540	540
11	513	661	798	893
12	2,529	3,028	3,489	3,804
--[a]	4,077	4,111	4,142	4,162
TOTALS:	21,858	25,419	28,775	31,100

Notes: 1 Model nodes were shown in Figure 2.6.2-1.

a These populations (1992 equivalent flow = 0.62 mgd) were assigned to a subarea tributary to the Crow Creek - Dry Creek diversion sewer. This pipeline has a capacity of 10 mgd at the critical section and was not modeled.

Table 3.5.2-3

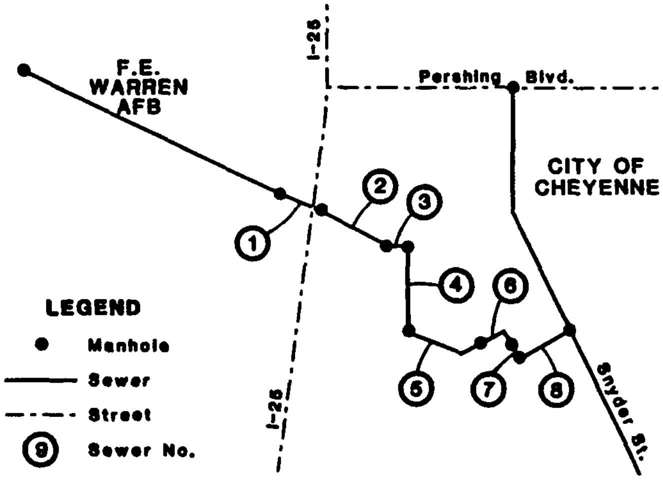
BASELINE POPULATIONS ALLOCATED TO THE
SOUTH CHEYENNE SEWER SYSTEM MODEL NODES

Model Node No.[1]	Baseline Populations 1983	1987	1990	1992
1	690	720	720	720
2	270	290	290	320
3	859	859	859	859
4	88	88	88	88
5	36	36	36	36
6	131	141	141	156
7	58	58	58	58
8	470	500	550	550
9	442	452	452	482
10	117	117	117	117
11	648	668	668	668
12	300	300	300	300
13	65	65	75	75
14	152	152	182	182
15	291	291	291	291
16	37	37	37	37
17	65	65	65	65
18	1,483	1,483	1,483	1,483
19	0	20	80	135
20	48	248	348	395
21	0	47	47	47
22	0	103	303	396
TOTALS:	6,250	6,740	7,190	7,460

Note: 1 Model nodes were shown in Figure 2.6.2-2.

Table 3.5.2-4

CAPACITY AND REPLACEMENT COST OF SEWER SERVING
F.E. WARREN AFB



Pipe Capacity

Pipe No.	Q[1] (CFS)	Existing Status[2]	Existing Pipe Size (in)	Existing Pipe Capacity (CFS)	% Capacity	Proposed Pipe Size (in)	Proposed Pipe Capacity (CFS)
1	2.13	OK	15	3.36	63	N/A	
2	2.84	OK	12	4.07	70	N/A	
3	2.84	OK	12	3.83	74	N/A	
4	2.84	C	12	2.90	98	15"	5.25
5	2.84	S	12	2.32	122	15"	4.20
6	2.84	S	12	2.55	111	15"	4.63
7	2.84	S	12	2.05	139	15"	3.72
8	2.84	S	12	2.34	121	15"	4.25

Replacement Cost

Pipe No.	Length (ft)	Diameter, inches Existing Pipe	Diameter, inches Proposed Pipe	Replacement Cost @ $40.00/Linear foot	Total Cost
1	350	15	N/A	N/A	
2	620	12	N/A	N/A	
3	170	12	N/A	N/A	
4	1,025	12	15	41,000	
5	850	12	15	34,000	
6	450	12	15	18,000	
7	200	12	15	8,000	
8	700	12	15	28,000	$129,000

Notes: 1 Q = Sum of peak inflows.
2 S - Surcharged pipe.
OK - Pipe has adequate capacity.
C - Pipe near capacity, recommend replacement.
N/A - Not Applicable.

Table 3.5.2-5

WASTE FLOWS FOR BASELINE CONDITIONS
IN THE CHEYENNE URBAN AREA

	Waste Flows (mgd)									
Location	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Waste Generation by Basin - Average Daily Flows										
Crow Creek	4.61	4.65	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70
Dry Creek	3.30	3.33	3.46	3.60	3.77	3.94	4.11	4.28	4.48	4.64
South Cheyenne	0.67	0.68	0.69	0.71	0.72	0.74	0.75	0.77	0.78	0.80
TOTAL:	8.58	8.66	8.85	9.01	9.19	9.38	9.56	9.75	9.96	10.14
Waste Generation by Basin - Peak Monthly Flows										
Crow Creek	5.5	5.5	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Dry Creek	4.0	4.04	4.19	4.36	4.57	4.78	4.98	5.19	5.43	5.62
South Cheyenne	0.76	0.77	0.78	0.81	0.82	0.84	0.85	0.87	0.88	0.90
TOTAL:	10.26	10.31	10.57	10.77	10.99	11.22	11.43	11.66	11.91	12.12
Wastes Treated by Plants - Average Daily Flows										
Crow Creek	4.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dry Creek	3.61	3.98	4.16	4.30	4.47	4.64	4.81	4.98	5.18	5.34
South Cheyenne	0.67	0.68	0.69	0.71	0.72	0.74	0.75	0.77	0.78	0.80
TOTAL:	8.58	8.66	8.85	9.01	9.19	9.38	9.56	9.75	9.96	10.14
Wastes Received by Plants - Peak Monthly Flows										
Crow Creek	5.5	4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dry Creek	4.0	5.04	5.79	5.96	6.17	6.38	6.58	6.79	7.03	7.22
South Cheyenne	0.76	0.77	0.78	0.81	0.82	0.84	0.85	0.87	0.88	0.90
TOTAL:	10.26	10.31	10.57	10.77	10.99	11.22	11.43	11.66	11.91	12.12

average flows at the Dry Creek plant will exceed capacity (5.04 vs. 4.5 mgd) by 1984, and they will be 6.17 mgd by 1987 and 7.22 mgd by 1992. The South Cheyenne plant, if not closed and its wastes sent to Crow Creek and thence to Dry Creek in accord with the existing Plan, will have reached 0.80 mgd average flow and 0.90 mgd peak-monthly flow.

3.5.2.1.2 All Other Communities

3.5.2.1.2.1 Chugwater, Wyoming

Chugwater is expected to grow from 230 to 310 people by 1991 and to stabilize there through 1992. The 35-percent growth is likely to strain the capacity of the existing 2 acres of evaporative ponds, which currently are evaporating roughly one-quarter of the wastes they receive. Indeed by 1985, when the population will have grown by only 20 people, more overtopping incidents and spillages of untreated wastewater into adjacent fields will occur, such as have occurred on occasion already. It seems prudent for the community to expand its waste lagoon system now for anticipated waste flow increases to be expected by the end of the century. Only a 1-acre (50 percent) expansion would be required. It is anticipated that such an expansion will take place during or before 1985.

3.5.2.1.2.2 Gering, Nebraska

A baseline growth rate equal to approximately 290 people per year has been projected. By 1992, therefore, there will be 11,180 residents, compared to 8,560 today - a growth of 2,620 persons. Because the sewer system is rated adequate by the City today, it is assumed that the sewers will remain adequate for this growth, or that the City will be making routine (3 percent per year) expansions to the sewer system as required.

The treatment plant has already been shown to have excess capacity equal to 0.58 mgd (equivalent to an additional 4,874 people). On that basis, the plant should be more than adequate to handle the flows contributed by an additional 2,620 people.

3.5.2.1.2.3 Kimball, Nebraska

It is projected that the population of Kimball will increase during the baseline period from 3,140 in 1983 to 3,220 in 1992. This means that the sewer system should continue to function adequately with maintenance but no new sewers added, and it means that excess capacity will exist at the treatment plant. Specifically, the excess capacity would be for 2,390 people (5,760 - 3,220 - 150).

3.5.2.1.2.4 Pine Bluffs, Wyoming

Pine Bluffs is expected to grow from 1,117 in 1983 to 1,245 by 1992. The lagoon expansion currently under design to accommodate a design population of 1,600 will be more than adequate to accept the flows of all populations throughout the baseline period.

3.5.2.1.2.5 Scottsbluff, Nebraska

The projected future trend without the project for sewage treatment in Scottsbluff is only an 800-person change in population over the entire baseline period (1983 to 1992). Based on current excess capacity, no additions to sewage collection or waste treatment systems will be necessary. The waste treatment plant was upgraded in June 1983, and no further expansions are contemplated. Excess treatment capacity, on an average-day basis, currently exists for an additional 3,699 people.

3.5.2.1.2.6 Torrington, Wyoming

Torrington is projected to grow to 6,970 people by 1992. This population will produce a flow of 0.70 mgd at the current wastewater generation rate of 100 gpcd. Since the current lagoon system has a capacity of 1.2 mgd, if permitted to discharge by the town officials (which they are legally able to do), baseline expansions to the lagoon system will not be necessary. It remains possible, however, that the town will choose to expand its lagoons such that there will still be no need to discharge treated effluent.

3.5.2.1.2.7 Wheatland, Wyoming

Without the project, excess treatment capacity currently exists for an additional 2,754 people (0.19 mgd), based on an assumed current flow of 0.31 mgd, 66 gpcd, and available capacity of 0.5 mgd. Population projections for the baseline period indicate that the population will grow by 1,070 people by 1992. Since these additional people will generate only 0.07 mgd of sewage, no changes in the sewage treatment system can be anticipated.

3.5.2.2 Proposed Action

3.5.2.2.1 Cheyenne Urban Area

3.5.2.2.1.1 Sanitary Sewers

Computer modeling of the Crow Creek, Dry Creek, and South Cheyenne drainage basins was performed for the project impact years 1987, 1990, and 1992. The populations contributing to wastewater hydrographs used in the SWMM computer model are listed in Tables 3.5.2-6 and 3.5.2-7. The corresponding hydrograph input node locations were shown previously in Figures 2.6.2-1 and 2.6.2-2.

All computer simulations with impact populations gave the same results as baseline conditions. In each case, all of the sewers in each basin had adequate capacity to carry projected sewer flows, except some of the lines serving F.E. Warren AFB. The locations of the surcharged pipes, their lengths, and the capacity exceeded were discussed fully in Section 3.5.2.1.1.1.

3.5.2.2.1.2 Treatment Plants

The population and flows contributing to the South Cheyenne plant and to the Crow Creek and Dry Creek plants combined over the project period (1983 to 1992) are given in Table 3.5.2-8.

Table 3.5.2-6

PROJECT POPULATIONS ALLOCATED TO CHEYENNE
SEWER SYSTEM MODEL NODES

Crow Creek Basin

Model Node No.[1]	Populations 1987	1990	1992
1	1,695	1,695	1,695
2	698	698	698
3	685	685	685
4	2,123	2,079	2,025
5	569	584	569
6	1,259	1,128	1,122
7	1,861	1,892	1,936
8	401	390	386
9	633	641	633
10	1,588	1,628	1,589
11	2,312	2,374	2,411
12	1,267	1,328	2,411
13	929	929	929
14	513	513	513
15	794	794	794
16	794	794	794
17	2,478	2,478	2,478
18	650	650	650
19	1,886	1,886	1,886
20	2,857	2,880	2,899
21	1,541	1,541	1,541
22	101	101	101
23[a]	3,000	3,000	3,000
24[a]	1,500	1,500	1,500
25[a]	1,500	1,500	1,500
TOTALS[a]:	31,264	31,318	31,330

Dry Creek Basin

Model Node No.[1]	Populations 1987	1990	1992
1	2,013	2,506	2,964
2	1,036	1,058	1,058
3	4,391	4,954	4,954
4	764	743	743
5	2,097	2,275	2,275
6	1,321	1,491	1,491
7	2,408	2,702	2,702
8	596	656	656
9	3,833	3,981	3,981
10	540	548	548
11	661	798	798
12	3,261	3,599	3,599
-[b]	4,122	4,145	4,145
TOTALS:	27,043	29,456	29,914

Notes: 1 Model Nodes were shown in Figure 2.6.2-1.
a While F.E. Warren AFB was modeled as having a population of 6,000 to account for infiltration/inflow, the actual population is 3,630, which the total reflects.
b These populations were assigned to a basin tributary to the Crow Creek-Dry Creek diversion sewer which was not modeled.

Table 3.5.2-7

PROJECT PERIOD POPULATIONS ALLOCATED TO SOUTH CHEYENNE SEWER SYSTEM MODEL NODES

Model Node No.[1]	Populations 1987	1990	1992
1	720	720	720
2	315	320	320
3	859	859	859
4	88	88	88
5	36	36	36
6	141	171	156
7	58	58	58
8	575	550	550
9	527	482	534
10	117	117	117
11	668	668	668
12	312	300	300
13	75	75	75
14	184	182	182
15	291	291	291
16	37	37	37
17	65	65	65
18	1,483	1,483	1,483
19	100	135	135
20	348	418	395
21	47	47	47
22	403	396	646
TOTALS:	7,399	7,448	7,712

Note: 1 Model node numbers were shown in Figure 2.6.2-2.

Table 3.5.2-8

SERVICE AREA POPULATIONS AND WASTE FLOWS FOR PROJECT CONDITIONS IN THE CHEYENNE URBAN AREA

Basin	Service Population									
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Crow Creek	30,733	31,086	31,708	31,704	31,714	31,713	31,672	31,549	31,441	31,441
Dry Creek	21,971	22,371	23,718	25,379	26,659	27,620	28,755	29,140	30,329	31,379
South Cheyenne	6,250	6,405	6,863	7,230	7,449	7,528	7,662	7,548	7,572	7,812
TOTAL:	58,954	59,862	62,289	64,313	65,822	66,861	68,089	68,237	69,342	70,627
	Sewage Generated, Average Day (mgd)									
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Crow Creek	4.61	4.66	4.76	4.76	4.76	4.76	4.75	4.73	4.72	4.72
Dry Creek	3.30	3.36	3.56	3.81	4.00	4.14	4.31	4.37	4.55	4.71
South Cheyenne	0.67	0.69	0.73	0.77	0.80	0.81	0.82	0.81	0.81	0.84
TOTAL:	8.58	8.71	9.05	9.34	9.56	9.71	9.88	9.91	10.08	10.27
	Sewage Treated, Average Day (mgd)									
Plant	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Crow Creek	4.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dry Creek	3.61	4.02	4.32	4.57	4.76	5.71	5.88	5.91	6.08	6.27
South Cheyenne	0.67	0.69	0.73	0.77	0.80	0	0	0	0	0
TOTAL:	8.58	8.71	9.05	9.34	9.56	9.71	9.88	9.91	10.08	10.27
TOTAL-Peak Mo.	10.26	10.37	10.84	11.21	11.48	11.66	11.85	11.87	12.07	12.29

The table shows tha+ despite a peak inmigration in 1987 and a net outmigration thereafter, total population and wasteflows will continue to increase (because the baseline populations will increase more quickly than the project's outmigration). As a consequence, the difference in average flows of wastewater with the project and without will occur in 1987 and will be 0.47 mgd (9.56-9.19) throughout the Cheyenne Urban Area (including South Cheyenne). The Crow Creek and Dry Creek flows alone will be higher with the project in 1987 by 0.2 mgd. The total flow in Cheyenne will be 8.76 mgd with the project and 8.47 mgd without the project, compared with a capacity in place (without 201 Plan improvements) of 8.5 mgd. While the average flow to the two plants will be marginally in excess of 8.5 mgd in 1987 with the project, the 201-Plan improvements and expansions should be near implementation then; and if they are not, it is feasible to treat as much as 5.5 mgd at the Crow Creek plant, even though only the nominal 4.0 mgd has been shown in the table. In other words, even the 8.76 mgd should be fully treatable with the facilities in place in 1987.

By 1992 the difference between flows with the project and without will have diminished to 0.13 mgd (10.27 vs. 10.14 mgd), because so few project-related inmigrants (906) will remain, many of them in South Cheyenne (where the unit per capita flow is only 107 gpcd). The average flow to the Crow Creek and Dry Creek plants alone, however, will have reached 9.43 mgd, which will be considerably in excess of the nominal 8.5 mgd capacity now available but barely above the 9.34 mgd then to be expected under baseline. It is barely feasible that as much as 10 mgd could be treated at the two plants during average periods (5.5 mgd at Crow Creek and 4.5 at Dry Creek), but the extended overloading of the Crow Creek plant would not be prudent. The 10 to 12 mgd peak flows throughout the project period for several months at a time, both with the project and without, suggest strongly the need for expanded treatment capacity at the Dry Creek plant as soon as possible. With the measurement error taken into account, it is to be noted that the Dry Creek plant will have to be expanded to at least 8 mgd to accommodate peak-month flows either in baseline or project conditions by 1992. (The current plan calls for expansion to 7.0 mgd.)

In summary, there is great significance to the early implementation of the 201 Facilities Plan. Implementation measures would include closing the South Cheyenne plant, piping those wastewaters to the Crow Creek plant, and diverting all flows greater than 4.0 mgd to the Dry Creek plant which will be expanded. This implementation will solve all existing, baseline period, and project period treatment problems. The currently estimated cost for implementing the 201 Plan is set forth in Table 3.5.2-9.

3.5.2.2.2 All Other Communities

3.5.2.2.2.1 Chugwater, Wyoming

With 50 additional inmigrants to Chugwater in the years 1985 through 1987, the total population will be raised to 300, 310, and 320. When the town has increased its pond size by 0.5 acre to correct the chronic overtopping problem occurring in the recent past, there will be capacity in the lagoon system for 345 people. Consequently, no further additions of treatment will be necessary. Also, the net housing demand in Chugwater is projected to be nonexistent to very minor even in the peak year (1985), so existing sewers should be able to carry the minor additions to wastewater flows.

Table 3.5.2-9

PHASED 201-PLAN COST SUMMARY

Phase I	Capital Cost, $	Operation and Maintenance Cost $/Year
Dry Creek Upgrade	$ 945,200	$375,280
Crow Creek Upgrade	729,150	295,580
South Cheyenne to Crow Creek	404,000	6,130
(Extraneous) Collection Lines		
Sunnyside	1,071,700	
North Cheyenne	562,040	
Planning & Engineering (15% of Cap. $)	556,810	
Total Phase I	$4,268,900	$676,990/yr in Phase I
Phase II		
Dry Creek Expansion	2,475,730	525,780
Crow Creek Operation		295,580
South Cheyenne to Crow Creek		6,130
TOTAL CAPITAL COST	$6,744,630	$827,490/yr in Phase II

Source: Banner Associates 1982.

3.5.2.2.2.2 Gering, Nebraska

In the peak year of project immigration (1988), 104 residents and 12 transients are expected to move to Gering. If all 116 contribute wastewater at 119 gpcd, the historical unit rate, wasteflow will be increased by 13,800 gallons per day. The baseline flow will be 1.517 mgd (9,970 x 119 gpcd + 0.331 mgd industrial flow). The project will raise this to 1.531 mgd. The capacity in place today is 1.932 mgd, so no additional waste treatment will be necessary; and the added flow is so small that the existing sanitary sewers can carry the added flow without expansion.

3.5.2.2.2.3 Kimball, Nebraska

The project's immigration to Kimball is projected to occur in 1987 and 1988. In the first year, 75 workers and dependents associated with the project will be living there. In 1988, that number will increase to 300.

The excess treatment capacity in Kimball today can accommodate 2,390 additional people. In 1988 the baseline population will have grown by only 40, and the 340 additional people with the project will barely impact the waste treatment operation which serves over 3,100 people now. The added 30,000 gallons per day of wastewater (and even a peak flow of perhaps 3 times as much) could be carried in any of the existing 8-inch sewers, so no sewer expansion will be necessary either.

3.5.2.2.2.4 Pine Bluffs, Wyoming

The planned near-future expansion of treatment to a capacity for 1,600 people will more than accommodate the 1,186 baseline population in 1988, plus the 150 project immigrants expected to arrive in that year and to remain only until 1989. No changes to sewers or treatment facilities will be necessary.

3.5.2.2.2.5 Scottsbluff, Nebraska

Project-induced immigration is projected to begin at Scottsbluff in 1986 when 67 people, including workers, their families, and/or project-induced indirect service people, will move into Scottsbluff. As the project work increases around Scottsbluff in 1987 and 1988, other project-related inmigrants are projected to be added.

The peak immigration of 234 people will affect the waste collection and treatment systems by an increase in wastewater flow of 40,480 gallons per day (234 x 173 gpcd). This will represent a small change in the citywide average wastewater flow from 2.5 mgd to 2.54 mgd. Accordingly, there would be no demonstrable impact on the collection system or the waste treatment plant. Scottsbluff has an excess treatment capacity for 3,699 people, and only 234 in the maximum year are being added.

3.5.2.2.2.6 Torrington, Wyoming

Immigrants will locate in Torrington only in 1987. In that year there will be 199 residents and 26 transients induced by the project. Waste flows should increase by roughly 0.02 mgd (225 x 100 gpcd). This represents only a 3.7-percent (225/6,070) increase in population and wasteflow over the 1987

baseline condition. Treatment required will be 0.63 mgd, and Torrington's waste lagoon system today has 1.2 mgd of capacity. No wastewater impacts can be anticipated.

3.5.2.2.2.9 Wheatland, Wyoming

Population projections reveal that immigration would begin in 1985 with the peak number of additional people, 450, residing in Wheatland during 1986. The presence of a maximum of 450 additional people in Wheatland would increase the wastewater flow by 31,050 gallons per day based on the present per capita flow of 69 gpcd. This would cause a 9 percent increase in the baseline wastewater flow and not require any additions to waste treatment facilities, since excess capacity for over 2,000 people exists today.

3.5.3 Solid Waste

3.5.3.1 Baseline Future - No Action Alternative

3.5.3.1.1 Cheyenne Urban Area

3.5.3.1.1.1 City Refuse Disposal

Under present growth trends, the population of the city of Cheyenne is expected to increase by 6,063 to 66,844 over the period 1983 to 1990. As a result of this 10 percent increase, the City of Cheyenne will be responsible for the collection of an estimated 15 tons per day (T/day) of additional solid wastes by 1990.

The City of Cheyenne's collection fleet is operating at a level approaching its design capacity. The projected growth in population and solid waste generation will require some expansion to the present collection and disposal operation. Currently, the City collects wastes along 11 routes and will soon be requiring the addition of a 12th route. The growth in population in the baseline period is expected to force a further increase to 13 routes (each with one collection vehicle and a three-man crew). The solid waste quantities to be generated during the No Action years are shown in Table 3.5.3-1 along with the Proposed Action loads.

At the same time, the City's landfill will be receiving increasing quantities of waste for disposal. The closure of the F.E. Warren AFB landfill, and the increase in residential, commercial, and industrial wastes requiring disposal at the Cheyenne landfill will also force the need for additional landfill equipment and equipment operators. The landfill is currently receiving approximately 185 T/day of waste for disposal. As waste tonnage approaches 200 to 225 T/day, an additional compactor (and operator) will become necessary. This threshold level will be reached by 1988.

As described earlier, the City is considering a proposal to construct a waste transfer station. This transfer station, depending on its location, capacity, and design could reduce the need for additional collection vehicles and crews by improving the overall efficiency of the collection and disposal operation.

Table 3.5.3-1

SOLID WASTE GENERATION WITHIN THE REGION OF INFLUENCE

Location		Tons/Day									
		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Cheyenne	BF[1]	121.5	122.8	125.7	128.0	130.7	133.5	136.4	139.2	142.2	145.1
	PA[2]	121.5	123.3	128.0	132.3	135.6	138.0	140.7	141.3	143.9	146.7
South Cheyenne and Urban Fringe	BF	32.0	32.4	33.3	34.0	34.9	35.7	36.6	37.5	38.5	39.3
	PA	32.0	32.6	34.1	35.3	36.3	37.0	37.9	38.2	39.1	39.9
F.E. Warren AFB	BF	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	PA	5.0	6.2	6.2	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Subtotal for Cheyenne Urban Area	BF	158.5	160.2	164.0	167.0	170.6	174.2	178.0	181.7	185.7	189.4
	PA	158.5	162.1	168.3	172.6	176.9	180.0	183.6	184.5	188.0	191.6
Total for Cheyenne Urban Area[3]	BF	182	184	189	192	196	200	205	209	214	218
	PA	.32	186	194	198	203	207	211	212	216	220
Chugwater	BF	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.8
	PA	0.6	0.6	0.8	0.8	0.8	0.7	0.7	0.7	0.8	0.8
Gering	BF	21.4	22.1	22.8	23.5	24.2	24.9	25.6	26.4	27.1	27.9
	PA	21.4	22.1	22.8	23.6	24.3	25.2	25.9	26.4	27.1	27.9
Kimball	BF	7.8	7.8	7.9	7.9	7.9	7.9	8.0	8.0	8.0	8.0
	PA	7.8	7.8	7.9	7.9	8.0	8.1	8.7	8.0	8.0	8.0
Pine Bluffs	BF	2.8	2.8	2.9	2.9	2.9	3.0	3.0	3.0	3.1	3.1
	PA	2.8	2.8	2.9	2.9	2.9	3.3	3.0	3.0	3.1	3.1
Scottsbluff	BF	36.1	36.3	36.6	36.8	37.0	37.1	37.3	37.5	37.7	37.8
	PA	36.1	36.3	36.6	36.9	37.1	37.7	37.8	37.5	37.7	37.8
Torrington	BF	13.8	14.0	14.2	14.7	15.2	15.6	16.2	16.7	17.0	17.4
	PA	13.8	14.0	14.2	14.7	15.7	15.6	16.2	16.7	17.0	17.4
Wheatland	BF	11.3	11.5	11.8	12.0	12.3	12.6	13.0	13.3	13.6	14.0
	PA	11.3	11.5	12.2	13.1	12.8	12.6	13.0	13.3	13.6	14.0

Notes: 1 Baseline Future - No Action Alternative.
2 Proposed Action Alternative.
3 Includes 15 percent contribution to landfill by private, unserved individuals and construction activity.

3.5.3.1.1.2 South Cheyenne and Urban Fringe Areas

The populations of South Cheyenne and the urban fringe areas east and west of Cheyenne are projected to increase by 2,910 people, or 22.7 percent, between 1983 and 1992. Solid waste generation will rise similarly, from 32 T/day in 1983 to 39.3 T/day in 1992.

Bronco Disposal Service and Fox Sanitation Company each have excess collection capacity on hand now and are actively seeking greater business, including growth to a degree that further collection equipment would have to be leased or purchased. Expansion of business by 22.7 percent in 9 years, an average of only 2.5 percent per year, actually may not be enough to suit the entrepreneurs involved, and their search for new business may expand to other areas.

3.5.3.1.1.3 Toxic and Hazardous Wastes

Private waste generators ship for treatment at existing out-of-state permitted sites those toxic and hazardous wastes generated in the private sectors of the Cheyenne Urban Area (and the rest of the Region of Influence). These practices can be assumed to continue in the future.

Currently and for the foreseeable future without the project, the only toxic or hazardous material generated and stored at F.E. Warren AFB will be a dilute solution of sodium chromate from the Minuteman missile support equipment. Approximately 500 pounds are generated per month, and this will continue to be the rate of generation. The Defense Property Disposal Office has responsibility for periodic shipment to an approved site of accumulated material of this type.

All other toxic and hazardous materials generated on the base are routinely sold for recycling or hauled away for reclamation. These include 500 gallons per month of contaminated fuels and spent lubricants which are sold for $0.18 per gallon; 275 gallons of contaminated helicopter fuel per month which is recycled by the Defense Property Disposal Office; and a very small quantity of spent battery acid (H_2SO_4) which is recycled locally by Wycon Chemical Company.

3.5.3.1.2 All Other Communities

3.5.3.1.2.1 Chugwater, Wyoming

Chugwater's population has been projected to increase from 230 in 1983 to 310 in 1992. A similar increase in solid wastes can be expected. Loads will increase from 0.6 T/day to 0.8 T/day. This will cause little or no impact on the town's collection and disposal capability, especially when it is recalled that residents burn their combustible wastes first and set out only the ashes and the noncombustibles for collection. For conservative estimation purposes, the full 5.0 ppcd unit generation rate has been used, but the unit load in Chugwater is obviously lower as a result of the initial incineration.

3.5.3.1.2.2 Gering, Nebraska

The population of Gering is projected to increase by 30.6 percent over the 1983 to 1992 period. During this time solid waste generation will similarly increase, rising from 21 T/day in 1983 to 28 T/day in 1992.

Gering does not operate a public waste collection system, choosing to contract with a private firm. All indications are that the City has found this arrangement satisfactory and will continue with it for the foreseeable future. The City does own and operate the landfill site which, under present disposal levels, has a remaining life conservatively estimated at 25 years. While the percentage increase in solid waste generation through 1992 may appear high as a percentage, the relatively low level of wastes actually requiring disposal is not expected to pose a serious impact on the equipment, manpower, or levels of expenditure necessary to operate the system.

3.5.3.1.2.3 Kimball, Nebraska

Kimball has experienced a sharp decline in its population since 1970. Projections show only a slight (2.5 percent) increase in population through 1992. As a result, the quantity of solid wastes generated in Kimball will also increase only slightly. Based on projections of population for Kimball, the quantity of solid waste generated will increase from an average of 7.8 T/day in 1983 to 8.1 T/day in 1992, a rise of 3.8 percent.

Kimball does not operate a public solid waste collection and disposal system, choosing instead to contract with private firms. All indications are that the City is satisfied with this arrangement and will continue with it in the future. The increases in waste generation are not expected to affect the collection and disposal systems currently in operation other than to reduce the life of the City's 98-acre landfill to slightly less than its 50-year capacity. Furthermore, there is no adverse solid waste effect predicted for City government expenditures, public health and safety, or environmental quality during this time.

3.5.3.1.2.4 Pine Bluffs, Wyoming

The population of Pine Bluffs has been projected to increase from 1,117 people in 1983 to 1,245 people by 1992. This represents an 11 percent growth in population, or an average rate of 1.2 percent annually. As a result of this increase, additional quantities of solid waste will be generated, requiring additional collection and disposal. The additional wastes generated are expected to total approximately 0.32 tons per day or 0.64 cubic yards (cy).

An examination of current collection and disposal practices in Pine Bluffs indicates that the available capacity of both the present waste collection system serving the city and the landfill capacity available at a new site near Burns, Wyoming (to which Pine Bluffs wastes are to be transported after 1985) are more than sufficient to handle the additional wastes generated during the 1983 to 1992 period.

3.5.3.1.2.5 Scottsbluff, Nebraska

Scottsbluff's population is expected to grow by 4.8 percent between 1983 and 1992. Solid waste generation will increase in like fashion. Accordingly, daily loads will increase from 36.1 tons in 1983 to 37.9 tons in 1992. The current collection fleet and 125 acres of excess disposal area at the landfill are more than adequate to accommodate this anticipated increase in loads.

3.5.3.1.2.6 Torrington, Wyoming

The population of Torrington is projected to increase even in the absence of the project. Torrington's population is projected to grow from 5,540 in 1983 to 6,970 by 1992, a 25.5-percent increase or 2.9 percent annually.

Similarly, solid waste quantities will increase from approximately 13.9 T/day in 1983 to 17.4 T/day by 1992, an actual increase of 3.5 T/day.

A review of Torrington's collection and disposal system has revealed that the available capacity of the City's collection fleet (including spare vehicles), together with efficiencies provided by its baler and balefill, are more than adequate to handle the additional wastes generated through 1992. Little or no impact is anticipated affecting Torrington's governmental expenditures for waste collection, public health and safety, or environmental quality.

3.5.3.1.2.7 Wheatland, Wyoming

Wheatland has recently experienced a sharp drop in population resulting from the completion of construction of the Laramie River Power Station project. The community's population has recently stabilized at 4,520, and it is projected to increase to 5,590 by 1992. Solid waste generation, therefore, will also increase, rising from 11 tons per day to 14 tons per day during this time.

With little change in waste generation rates, there will be no need to increase waste collection capability. Existing equipment, vehicles, and manpower levels will be maintained. With the pending acquisition of additional acreage for landfilling purposes, Wheatland should face no unusual problems in meeting waste disposal obligations for the foreseeable future.

3.5.3.2 Proposed Action

3.5.3.2.1 Community Garbage Disposal

With the exception of the city of Cheyenne, project-induced increases in garbage and other refuse loads would not require new equipment, crews, or disposal-site acreage at any ACS community between 1983 and 1992. This includes conditions with the project or any of its alternatives, none of which would generate greater solid waste loads.

Cheyenne's solid waste loads will be increased by another truckload's capacity (10.8 T/day) by 1987, one year earlier than under baseline-future conditions. Moreover, loads at the City's landfill site will have reached an equipment threshold (200 T/day) by 1986. (This projection includes consideration of loads of 15 percent of the collected load which represents commercial construction wastes and deliveries by unserved individuals which

are now accepted from outlying areas not within the Cheyenne Urban Area as defined here but in nearby Laramie County).

In summary, the project will accelerate the need for 1 additional collection vehicle and crew (from 1988 to 1986) and the need for a new compactor and operator at the disposal site (from 1988 to 1987). This impact is rated as low and not significant at the local level because this impact has been predicted already at the local level, and because the added equipment can be purchased easily by the City and the costs passed to the customers almost unnoticed. (A $64,500 truck and an $180,000 compactor, financed at 8 percent interest, would add roughly $1.90 per month to the household costs of only the 2,363 project-induced new customers. Spread to the roughly 20,000 baseline customers as well, who will require the equipment eventually, the average homeowner's cost would be even smaller.) No irreversible or irretrievable commitments of resources or long or short-term uses of the environment will ensue.

All project-induced solid waste loads, along with baseline loads, were shown earlier in Table 3.5.3-1.

3.5.3.2.2 Toxic and Hazardous Wastes

Hazardous waste generation at F.E. Warren AFB specifically related to the project is expected to be much the same in quantity and character as the materials generated in the Minuteman program now.

The materials generated with the project will be expended oils and lubricants, paints and thinners, hydraulic and machining fluids, cleaning agents, and adhesives. Federal and state laws regarding the handling and disposal of these wastes will be followed as they are now. Hence, there will be no toxic and hazardous waste impacts at the base.

No nuclear waste will be produced or stored at F.E. Warren AFB.

Toxic and hazardous waste generation in the remainder of the Region of Influence is not expected to change with the project, and baseline collection and recycling activities are projected to remain the same.

3.5.3.2.3 Disposal of Construction-Period Wastes

During the most intense construction period (1984 and 1985) at F.E. Warren AFB, considerable renovation or removal of existing buildings and removal of pavement will occur.

A Corps of Engineers estimate of building materials to be discarded has placed the volume at 580 cy. This material will include broken pavement that must be removed (over half the load) and structural members, walls, and roofing from small buildings that are to be removed. At a compacted weight of 80 pounds per cubic foot (lb/cf), the total load of discarded material will be 626 tons over the 2 years.

The disposal practice most predictable will be the use of 25-cy dumpsters placed at individual building sites on the base by the construction contractors. The 580 cy of material will require 23.2 such dumpsters, which could be individually hauled to the City's disposal site. Local officials do not

anticipate that wastes in this low volume would impact the disposal-site operation.

Disposal of wastes generated in the balance of the Deployment Area (DA) during construction, including disposal of chemical-toilet wastes, will be the responsibility of individual contractors, acting in accordance with applicable state and local criteria.

3.5.4 Stormwater

3.5.4.1 Baseline Future - No Action Alternative

3.5.4.1.1 Cheyenne Urban Area

3.5.4.1.1.1 Baseline Findings

For all future growth cases, detailed analyses were made for hypothetical developments of single-family, multifamily, and mobile home tracts between 20 and 160 acres in size and with land slopes between 0.5 and 6.0 percent. Rational Method and other procedures were used as required by the City of Cheyenne and Laramie County Subdivision Regulations (1979) and by the Cheyenne Storm Water Management Planning Manual (circa. 1980).

Typical results for the required number of linear feet of storm sewers of various diameters, plus other appurtenances such as inlets and manholes, are given for 20, 40, 80, and 160-acre developments in Tables 3.5.4-1 and 3.5.4-2. The hypothetical street, inlet, and pipeline layouts are shown in Figures 3.5.4-1 through 3.5.4-3.

In the baseline period (1983 to 1992) the socioeconomic and land use efforts of the study have projected a need for 3,205 single-family units of housing and 1,157 multifamily dwelling units. Their densities have been assumed at 4 per acre and 12 per acre, respectively. Accordingly, about 800 acres of single family homes and 100 acres of multifamily homes will be required. This represents the gross demand for housing, so all these acres are likely not required to be newly developed. Nonetheless, the gross requirements would be essentially 10 times the 80-acre single-family development requirement for storm sewers given in Table 3.5.4-1, plus perhaps one of the 20-acre multifamily requirements given in Table 3.5.4-1 and two of the 40-acre multifamily requirements given in Table 3.5.4-2.

It should be noted well that these requirements do not include provision for drainage through a development of runoff generated in an upstream development. Such provisions are also required by local regulations, but it was impossible to specify precisely where these hypothetical developments would occur. So the storm sewers have been sized here as though the developments were themselves upstream and near a ridgeline. For developments actually occurring in downstream areas, still further storm drainage facilities to pass the inflowing runoff as well would be required. It is quite conceivable that these facilities would be larger and more costly than those indicated here for interior drainage.

The costs for providing storm sewers and detention ponds on all these hypothetical developments have also been estimated. The costs per acre ranged

Table 3.5.4-1

LINEAR FEET OF REQUIRED STORM SEWERS PLUS
OTHER APPURTENANCES FOR SELECTED
20-ACRE AND 80-ACRE DEVELOPMENTS

Pipe Diameter, Inches	20-Acre Developments[1]			80-Acre Developments[1]	
	Single Family	Multi-family	Mobile Home	Single Family	Mobile Home
15		964		1,194	420
18	300	1,024	240	954	738
24	534	542	528	1,068	888
30	207	60	204	354	2,344
36		391	120	1,792	468
42	120			354	438
48					204
54				120	
66					120
TOTAL FT:	1,161	2,981	1,092	5,836	5,620
No. Curb Inlets	10	12	8	36	32
No. Manholes	5	8	4	18	16
Acre-feet of Detention Storage[2]	1.3	1.7	1.5	6.0	8.0

Notes: 1 All developments on 2.0 percent slopes. Other slopes yield other distributions of pipe lengths among various sizes of pipe, but the total length remains the same.

2 Volume computed from City of Cheyenne storage equation for detention of 100-year flood peaks to predevelopment outflows.

Table 3.5.4-2

LINEAR FEET OF REQUIRED STORM SEWERS PLUS OTHER APPURTENANCES FOR SELECTED 40-ACRE AND 160-ACRE DEVELOPMENTS

Pipe Diameter, Inches	40-Acre Developments[1]			160-Acre Developments[2]	
	Single Family	Multi-family	Mobile Home	Single Family	Mobile Home
15	240	1,928	240	1,080	840
18	594	904	438	2,388	1,896
24	1,678	1,866	1,062	2,964	2,832
30	534	30	964	1,536	1,752
36	414	1,386	204	2,146	1,870
42	120	30		354	846
48		120	120		
54				964	964
60					
72				964	964
84				120	120
TOTAL FT:	3,580	6,264	3,028	12,516	12,084
No. Curb Inlets	40	24	16	72	64
No. Manholes	20	16	8	36	32
Acre-feet of Detention Storage[3]	3.20	4.14	3.54	10.98	12.22

Notes: 1 Development assumed on land with two slopes. Slope of upstream half = S_1 = 1.0%; downstream half = S_2 = 0.5%.

2 S_1 = 6.0%; S_2 = 3.0%.

3 Volume computed from City of Cheyenne storage equation for detention of 100-year flood peaks to predevelopment outflows.

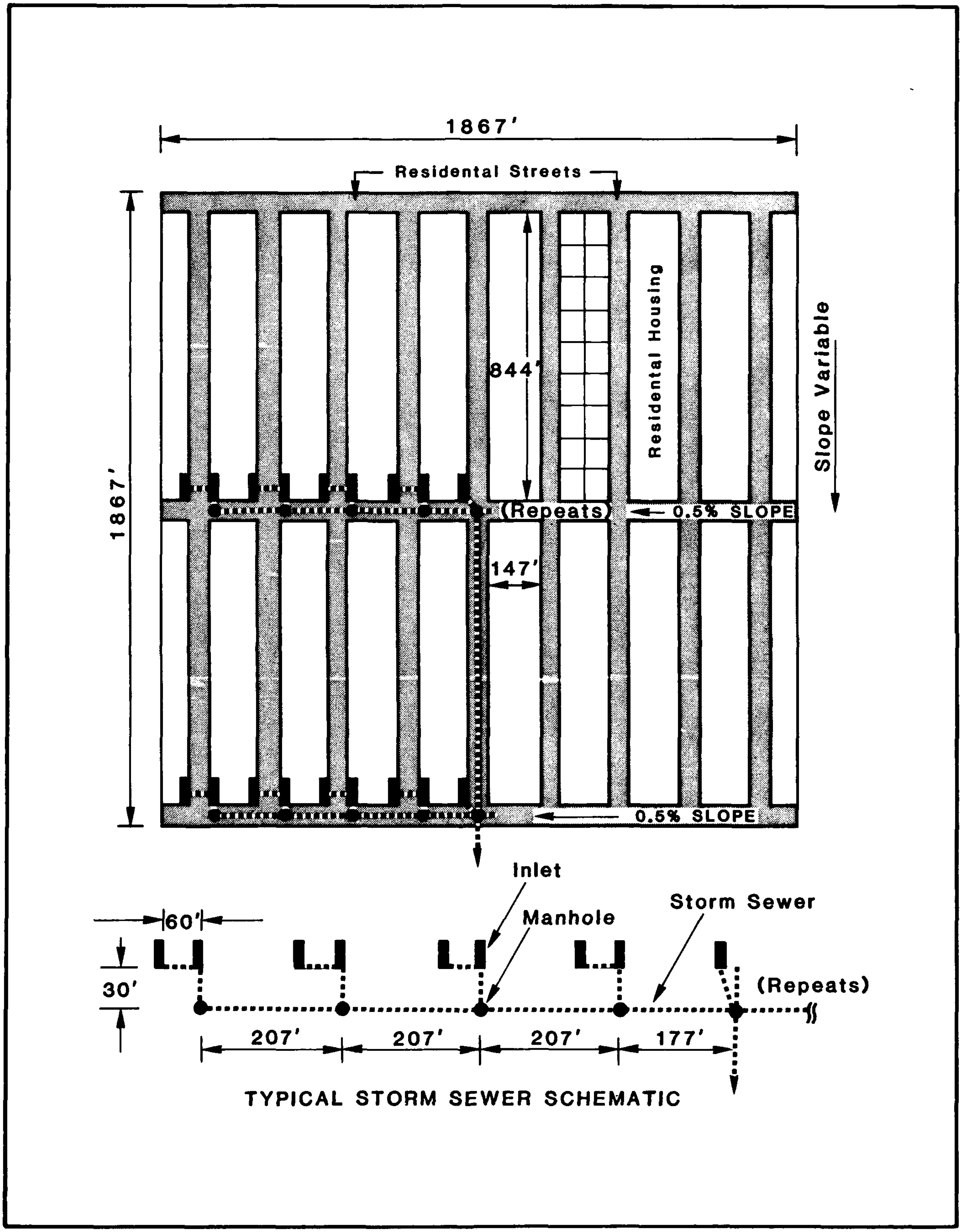


FIGURE 3.5.4-1 TYPICAL 80-ACRE SINGLE-FAMILY RESIDENTIAL LAYOUT

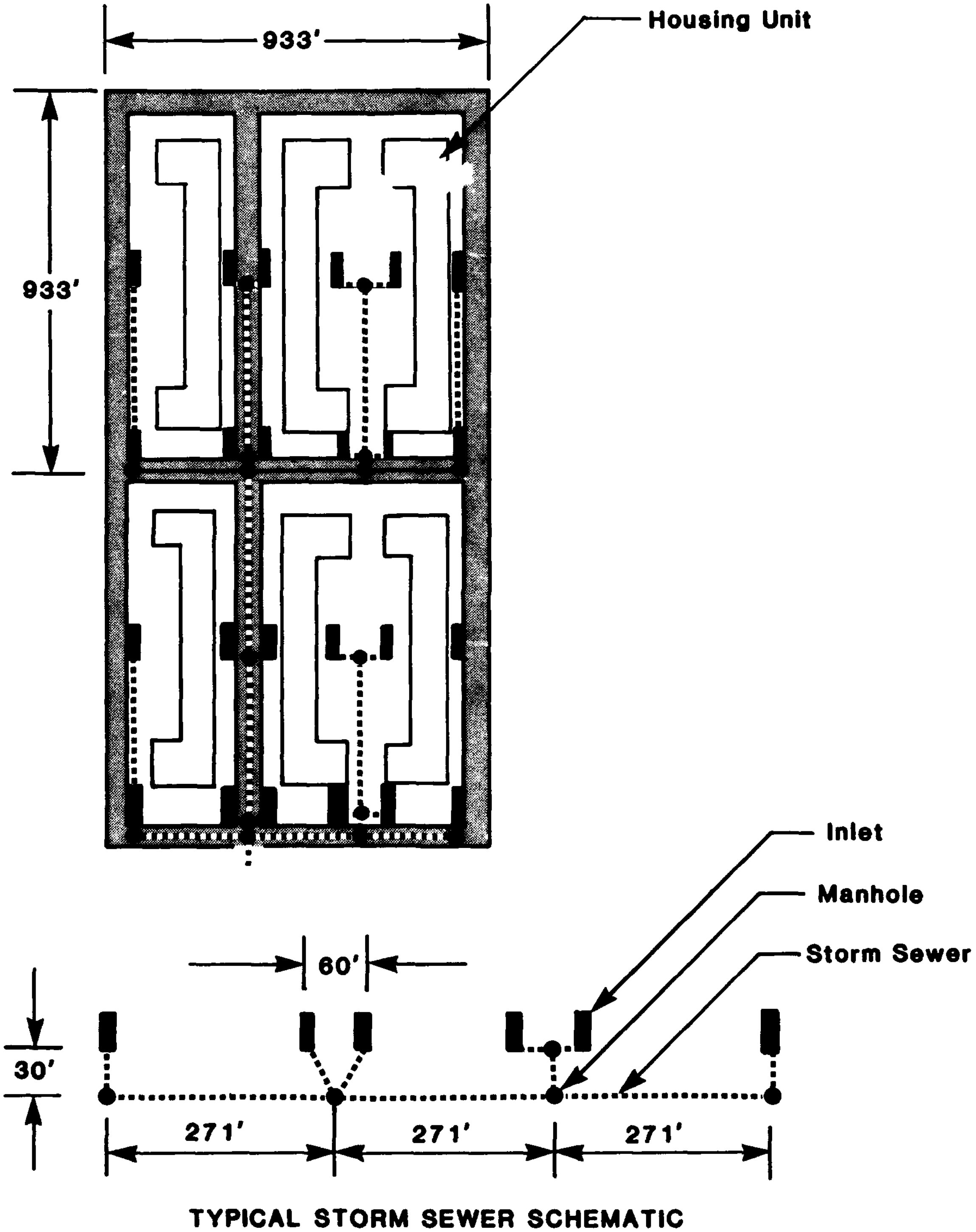


FIGURE 3.5.4-2 TYPICAL 20 AND 40-ACRE MULTIFAMILY DEVELOPMENT

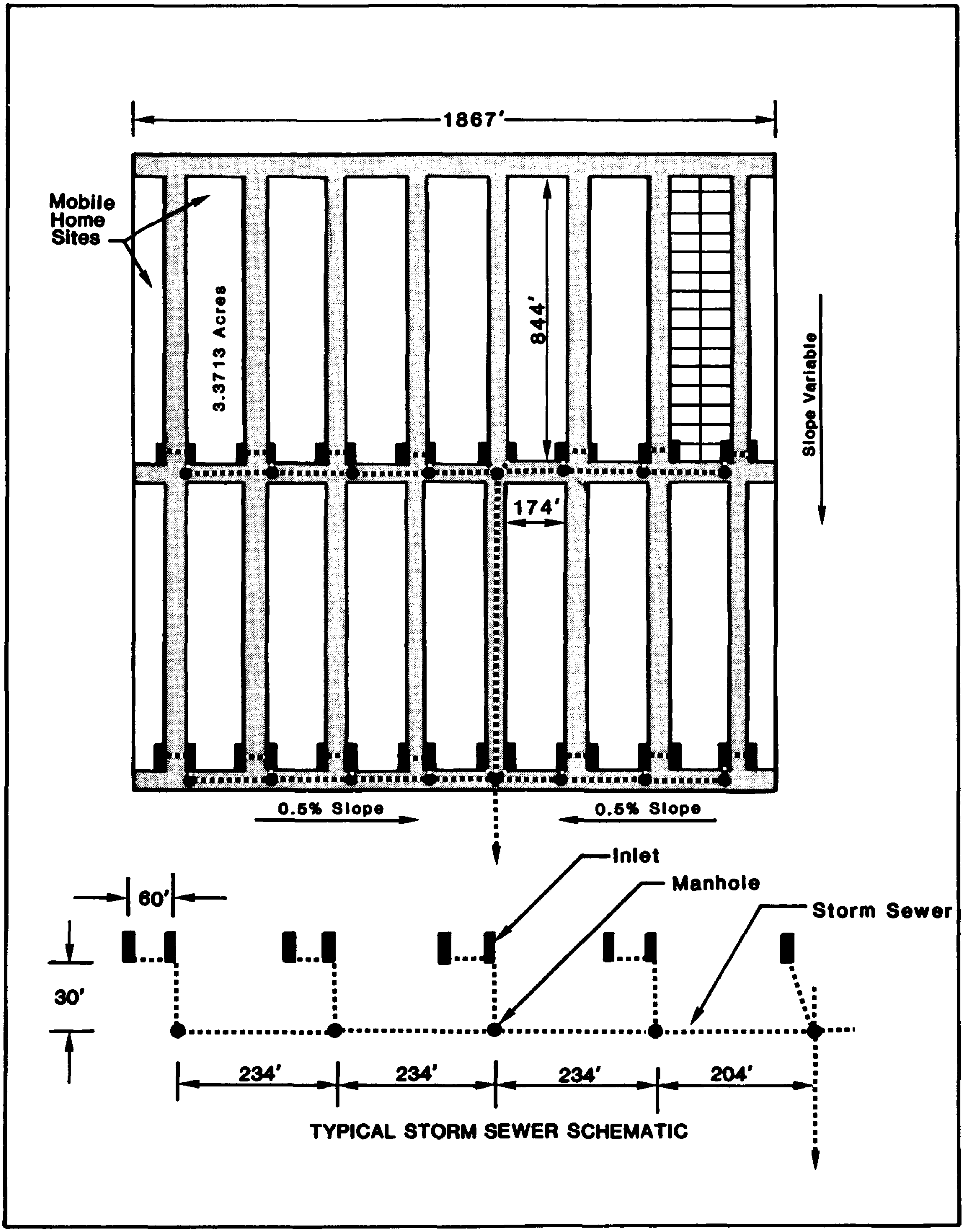


FIGURE 3.5.4-3 TYPICAL 80-ACRE MOBILE-HOME LAYOUT

from $6,390 for single-family homes in 40-acre developments with slopes of 6.0 and 3.0 percent, to $13,060 for multifamily dwellings on very low slopes but in similar 40-acre developments. These costs represent about $1,600 per dwelling for the single-family homes and $1,100 per dwelling for the multifamily units. It can be anticipated that the costs would be included in home costs or rents by the private developers. Maintenance costs have not been estimated rigorously, but they should be roughly half of the total annual cost of providing these facilities. In 30 years at 15 percent interest, the annualized construction would be $243 per single-family dwelling and $166 per multifamily dwelling. Maintenance costs, as estimated here, should be roughly equivalent.

The baseline growth in South Cheyenne has been projected to be 67 single-family homes and 605 mobile homes between 1983 and 1992. This growth will require roughly 20 acres of single-family home development (actually less than that) and 100 acres of mobile homes.

As shown in Table 3.5.4-1, a 20-acre single-family development will require 1,161 feet of storm sewers ranging in size from 18 to 42 inches. A 100-acre growth in mobile homes is South Cheyenne is probably best approximated as five 20-acre parks, each of which would require 1,092 feet of sewers ranging from 18 to 36 inches in diameter. The costs for the mobile-home areas would be $7,340 per acre (for the flat slopes in South Cheyenne; it would be higher on slightly steeper slopes). Amortized as before, this cost equals $1,223 per dwelling unit or $186 per year. The single-family home costs, by contrast, would be $7,720 per acre, but at only 4 per acre the unit cost would be $1,930 per dwelling unit or $293 per year per homeowner. A like amount may also be assessed by the developer, but perhaps more likely by the County, as a maintenance fee or tax.

3.5.4.1.1.2 Hydrologic Support

Very considerable detailed analyses have been performed of a wide range of possible development plans, roadway layouts, pipe slopes, detention requirements, and costs. Because it is impossible to specify exactly where and in what sizes actual subdivisions or mobile-home parks will be developed, the preceeding results may prove to be inaccurate. Therefore, a summary of the remaining possibilities for storm sewer and detention requirements is presented herein. It is to be noted that the ranges of facilities indicated could be applied equally well either to baseline or project-related developments.

First-Inlet Runoff. The Rational Method analysis for the Cheyenne Urban Area was applied on a per-inlet basis, and the downstream flows were routed either down streets as carry-over, surface drainage or as pipe flow in storm sewers starting at the first, upstream inlet. In this case, then, $Q = CiA$ was applied to drainage areas as small as 1.7 acres and to a per-inlet area not greater than 2.5 acres. The times of concentration, rainfall intensities, and resulting estimates of flow for the three kinds of land use are given in Table 3.5.4-3.

Outflows and Detention Storage. The peak 10-year storm outflow in cubic feet per second (cfs) are given in Table 3.5.4-4, along with acre-feet of storage required to detain 100-year storm runoff events to predevelopment levels. The

Table 3.5.4-3

FIRST-INLET RUNOFF COMPUTATIONS FOR VARIOUS LAND USES

Slope, %	C	A, acres	Time of Concentration, minutes	10-Year Intensity, i in/hr	Q, cfs	Pipe Flow, cfs	Carry-Over Flow to 2nd Inlet,
Single-Family Homes							
0.5	0.61	2.26	18.7	3.4	4.7	2.8	1.9
1.0	0.61	2.26	15.2	3.75	5.2	2.6	2.6
2.0	0.61	2.26	12.4	4.17	5.8	2.9	2.9
3.0	0.61	2.26	11.0	4.4	6.07	2.7	3.4
6.0	0.61	2.26	9.7	4.6	6.34	2.7	3.8
Multifamily Homes							
0.5	0.94	1.70	16.3	3.6	5.7	3.7	2.0
1.0	0.94	1.70	13.3	4.0	6.4	4.5	1.9
2.0	0.94	1.70	11.1	4.38	7.0	4.9	2.1
3.0	0.94	1.70	10.1	4.55	7.2	4.2	3.0
6.0	0.94	1.70	8.6	4.8	7.7	3.9	3.8
Mobile Homes							
0.5	0.66	2.50	18.7	3.4	5.6	3.6	2.0
1.0	0.66	2.50	15.2	3.75	6.2	4.3	1.9
2.0	0.66	2.50	12.4	4.17	6.9	4.8	2.1
3.0	0.66	2.50	11.0	4.4	7.3	4.4	2.9
6.0	0.66	2.50	9.7	4.6	7.6	5.0	2.6

Table 3.5.4-4

10-YEAR PEAK OUTFLOWS AND STORAGE REQUIREMENTS
(Q = Outflow in cfs; S = Storage in acre-feet)

	20-Acres		40-Acres		80-Acres		160-Acres	
Slope, %	Q	S	Q	S	Q	S	Q	S
Single-Family Homes								
0.5	47.0	1.62			155.8	7.21		
1.0	52.0	1.46			176.8	6.74		
3.0	60.9	1.19			208.0	5.69		
0.5 & 1.0			103.2	3.20			328.0	14.91
1.0 & 2.0			114.8	2.81			415.0	13.32
3.0 & 6.0			139.0	2.59			435.0	10.98
Mobile Homes								
0.5	62.4	1.78			200.0	7.96		
1.0	68.8	1.61			222.4	7.44		
3.0	80.0	1.31			246.4	6.29		
0.5 & 1.0			110.3	3.54			376.8	16.49
1.0 & 2.0			124.8	3.11			448.0	14.73
3.0 & 6.0			140.0	2.86			495.4	12.22
Multifamily Homes								
0.5	66.0	2.08						
1.0	74.4	1.88						
3.0	84.6	1.53						
0.5 & 1.0			142.8	4.14				
1.0 & 2.0			161.1	3.64				
3.0 & 6.0			175.8	3.36				

Cheyenne drainage criteria currently require developers to size storm sewers for the 10-year peak runoff event and to size detention facilities such that outflows from 100-year events will not exceed predevelopment levels, so there should be no increase in downstream flooding.

Drainage Costs. Very detailed cost estimates were made on a pipe-by-pipe, inlet-by-inlet basis for all the facilities outlined in Tables 3.5.4-1 and 3.5.4-2. They were derived from reported bid information and translated to Cheyenne and to January 1, 1984 with appropriate cost indices. The values for construction of storm sewers and detention ponds, in the units of dollars per dwelling unit, are given in Tables 3.5.4-5 and 3.5.4-6.

3.5.4.1.2 All Other Communities

3.5.4.1.2.1 Chugwater, Wyoming

Very little new housing development will be required to absorb the 80-person growth in Chugwater by 1992. Therefore, no changes in storm drainage will be required.

3.5.4.1.2.2 Gering, Nebraska

Gering is projected to grow from 8,560 to 11,180 by the year 1992, an increase of 2,620 persons. Assuming those additional persons all require new housing, 238 new acres of single-family development would be necessary: 2,620/(2.75 x 4 homes per acre). This would increase the developed area from roughly 1,000 acres to 1,238, and the C-value of 0.5 for the whole city would stay the same. Runoff would increase from 450 cfs to 557 cfs.

This increase in flow indicates a need to increase equivalent 60-inch storm outfalls for the city from 8 to 10, and to increase the number in the most developed area from 3 to 4.

Since few storm drains exist, and new developments are required to add storm sewers, it is presumed that those required additions will be made throughout the baseline period as new housing areas are developed. Standard practice is for private land developers to add these sewers and to incorporate their cost in the price of the new homes.

3.5.4.1.2.3 Kimball, Nebraska

Because the baseline population in Kimball is projected to increase by only 80 people throughout the 1983 to 1992 period, no new land development is likely. Accordingly, no increases in runoff rates can be projected, and no addition to storm drainage works will be necessary.

3.5.4.1.2.4 Pine Bluffs, Wyoming

A 128-person increase in population under baseline conditions between 1983 and 1992 has been projected. If all these persons required new housing, 11.6 acres of newly developed land would be necessary: 128/(2.75 x 4 homes per

Table 3.5.4-5

STORM DRAINAGE IMPROVEMENT COSTS FOR
20-ACRE AND 80-ACRE DEVELOPMENT SITES
(Dollars/Dwelling Unit)

		20-Acre Site			80-Acre Site		
Land Use	Slope %	Storm Sewers	Detention Pond	Total	Storm Sewers	Detention Pond	Total
Single-Family Homes	0.5	1,143	787	1,930	1,462	532	1,994
	1.0	1,157	787	1,944	1,415	485	1,900
	3.0	1,157	780	1,937	1,477	462	1,939
Mobile Homes	0.5	711	512	1,223	975	340	1,315
	1.0	754	471	1,225	977	308	1,285
	3.0	743	459	1,202	1,030	303	1,333
Multi-Family Homes	0.5	660	272	932			
	1.0	699	274	973			
	3.0	698	272	970			

Table 3.5.4-6

STORM DRAINAGE IMPROVEMENT COSTS FOR
40-ACRE AND 160-ACRE DEVELOPMENT SITES
(Dollars/Dwelling Unit)

Land Use	Slope % S_1	Slope % S_2	40-Acre Site Storm Sewers	40-Acre Site Detention Pond	40-Acre Site Total	160-Acre Site Storm Sewers	160-Acre Site Detention Pond	160-Acre Site Total
Single-Family	1.0	0.5	1,027	700	1,727	1,830	400	2,230
	2.0	1.0	1,027	617	1,644	1,722	392	2,114
	6.0	3.0	965	632	1,597	1,855	405	2,260
Mobile Home	1.0	0.5	928	427	1,355	1,236	254	1,490
	2.0	1.0	869	378	1,247	1,326	256	1,582
	6.0	3.0	889	374	1,263	1,337	260	1,597
Multi-family	1.0	0.5	842	246	1,088			
	2.0	1.0	770	222	922			
	6.0	2.0	743	226	969			

acre). The area of developed land would become 1,010.6 acres, and the new C-value would be:

$$C = \frac{0.5 \times 11.6 + 0.4 \times 1{,}000}{1{,}011.6} = 0.4011$$

Therefore, the peak runoff rate would be increased from the current rate of 360 cfs to 365.2 cfs. No changes in storm sewer facilities would be necessary to accommodate the small increase in peak flow.

However, it should be clarified that flooding does exist today. Table 2.6.4-3 showed that 7 equivalent 60-inch pipes would be necessary for draining the whole city, and 2 would be needed for the most concentrated commercial area. Only a mile of 18 to 36-inch sewers are in place. Pine Bluffs should consider, as a matter of providing baseline period protection, whether more storm sewers should be added.

3.5.4.1.2.5 Scottsbluff, Nebraska

By 1992 the population of Scottsbluff is projected to increase by 700 persons. If these residents all required new homes to be built, 64 new acres of single-family homes (700/2.75 x 4 homes per acre) would be required. This would increase the developed area from 3,160 to 3,224 acres and would not increase the C-value at all (0.5 being the value used for the city now and being the same value for urban-residential land on mild slopes). Therefore, peak runoff should increase from 790 cfs today to 806 cfs (0.5 x 0.5 x 3,224). No changes in the City's major facilities would be required to accommodate this slightly larger flow. This is not to say that new areas of development such as subdivisions should not have storm sewers installed. There is no indication that all 64 acres would be required, since available vacant homes could be used, and any new housing implied here is not likely to be in a single new development area.

3.5.4.1.2.6 Torrington, Wyoming

By 1992 the baseline population has been projected to increase by 1,430 people. At a maximum, all those people could require new housing. With 2.75 people assumed per household and 4 homes per acre, 130 new acres of residential housing would be required. This would increase the developed area from 1,500 to 1,630 acres, and the C-value for the whole town would increase to:

$$C = \frac{0.5 \times 130 + 0.4 \times 1{,}500}{1{,}630} = 0.408$$

The peak runoff would be increased from 540 to 598 cfs (0.408 x 0.9 x 1,630). The number of equivalent 60-inch sewers (10), but not the number of commercial area storm sewers required (4), would be increased by one. Accordingly, only one additional baseline storm sewer would be needed.

3.5.4.1.2.7 Wheatland, Wyoming

Wheatland's population is expected to increase by 1,070 by 1992. New housing for all these people will not be required, since there is available housing left vacant at the end of the Laramie River Power Station project. However, if half the people did require new housing, 49 acres of new single-family housing would be developed. The area of development would expand to 1,049 acres, and the new C-value would become:

$$C = \frac{0.5 \times 49 + 0.4 \times 1,000}{1,049} = 0.4047$$

The new runoff peak would be 382 cfs, instead of the current 360 cfs. No new storm drainage facilities would be required.

3.5.4.2 Proposed Action

3.5.4.2.1 Cheyenne Urban Area

The net housing demand with the project has been estimated by the socioeconomic and land use task groups to peak at 133 single-family homes and 9 multifamily units in 1986. This is for the city of Cheyenne alone. Hence, roughly 40 acres of single family homes and less than 1 acre of multifamily building will be required to be added above the baseline housing construction. The storm sewer requirements can be estimated from the 40-acre single-family home column in Table 3.5.4-2. Storm sewers ranging in size from 15 to 42 inches will be required. The annual costs for these storm sewers, inlets, manholes, and detention facilities will also approximate $243 per home (in 1984 dollars). The 40 acres of development compares to the 900 acres of baseline housing development, a 4.4-percent increase.

It is anticipated that the added storm sewers in Cheyenne will provide the mandated protection of the local homes against the 10-year event, and the detention provided should limit downstream flows to predevelopment levels. Like all baseline residents, the project-induced residents will pay for this protection through home mortgage or rent payments and perhaps through local taxes or assessments for maintenance. No adverse storm water impacts are predicted.

The net housing demand in South Cheyenne at the peak year (1987) has been projected to be 142 mobile homes and no single family dwellings. The storm sewer requirements to protect against the 10-year storm event and to detain the 100-year peak flood will be an additional 1,092 feet of storm sewers ranging in size from 18 to 36 inches in diameter. Other appurtenances are as shown previously in Table 3.5.4-1.

The immigrants could expect, as the new baseline residents could, to pay for these improvements at the rate of $1,223 per unit or $186 per year per home. Since these facilities and their costs are anticipated to be provided through private transactions, regulated by local ordinances already in place, no adverse stormwater impacts are anticipated.

3.5.4.2.2 All Other Communities

3.5.4.2.2.1 Chugwater, Wyoming

The projected net housing demand in Chugwater for the housing of immigrants is 6 mobile homes in 1985. No noticeable impacts on the storm runoff could be predicted, and no new facilities will be required.

3.5.4.2.2.2 Gering, Nebraska

There is a zero net housing demand projected for Gering. Hence, there will be no change in the landscape from induced new development and no increase in runoff. No stormwater facilities will have to be added above the baseline requirement.

3.5.4.2.2.3 Kimball, Nebraska

The net housing demand for the 300 immigrants in 1989 is projected to be only 9 mobile homes. This represents less than an acre of new development. Runoff will not be noticeably increased, and no new stormwater facilities will be needed.

3.5.4.2.2.4 Pine Bluffs, Wyoming

A maximum of 150 people is projected to immigrate to Pine Bluffs as a result of the project. The year of greatest change will be 1988. The 150 people will require very little new housing. The increase in peak runoff would be minimal and no new storm sewers over baseline facilities would be required.

3.5.4.2.2.5 Scottsbluff, Nebraska

The peak immigration year projected for the project is 1988, when 234 persons will move to Scottsbluff. This will bring the total population to 15,094, an increase of 654 persons over today.

The 700 people representing the entire No Action period growth were shown to increase peak storm flow by 16 cfs, and 654 new people would add roughly 15 cfs. No changes in citywide storm drainage facilities would be necessary to accommodate this level of growth.

3.5.4.2.2.6 Torrington, Wyoming

The peak immigration year is 1987, when 199 new residents are projected to move to Torrington. This will increase the baseline population for that year from 6,070 to 6,269. Because the project-induced population is less than that projected for 1992, new land development will be less than that under baseline conditions. No new storm sewers will be required with the project.

3.5.4.2.2.7 Wheatland, Wyoming

A maximum of 403 resident immigrants have been projected for Wheatland in 1986. Few inmigrants require new housing, however, and the net housing demand in Wheatland is only 1 acre of multifamily homes. No new storm drainage facilities would be necessary to accommodate such a slight increase in resulting flow.

3.5.5 Telephone Service

3.5.5.1 Baseline Future - No Action Alternative

3.5.5.1.1 Cheyenne Urban Area

The baseline growth rate for the number of new telephone customers in the Cheyenne Urban Area is projected by Mountain Bell to be between 2.3 percent and 3.3 percent through 1988. Table 3.5.5-1 shows the number of customers projected through 1992. The 1989 to 1992 values were derived from an assumption of a 3.0 percent growth rate for those years. It is projected that by 1992, Mountain Bell's customer load will increase to over 43,800, a 30-percent increase over 1983. The rate of new installations in the latter half of the 1980s will be between 1,100 and 1,300 per year. The existing capacity in the Cheyenne central office will be exceeded sometime before the end of 1984. Prior to that time it is expected that Bell would increase and upgrade its central office capacity sufficiently to meet additional customer demands.

3.5.5.1.2 All Other Communities

3.5.5.1.2.1 Chugwater, Wyoming

The Chugwater Telephone Company has experienced little or no growth in service demand over the past few years. The company does expect slight increases in service requirements by 1987, but the rate of growth has not yet been projected.

Baseline-period growth in Chugwater is not expected to exceed central office capacity (200 lines and 300 numbers) through 1992.

3.5.5.1.2.2 Gering, Nebraska

Systemwide growth in United Telephone Company of the West has been about 2.2 percent per year. Should that rate of growth continue, 270 new customers would be added in Gering by the end of 1985, exhausting existing capacity. Presumably, the company will judge whether its growth rate is continuing and will upgrade its capacity by 1985 if growth continues. The size of such an expansion that United Telephone will judge to be appropriate cannot be currently predicted (July 1983). Gering's growth has been projected in this work to be higher than 2.2 percent, actually 2.4 to 2.9 percent. At the higher rate, which will occur early in the baseline period, 361 new customers would be added by the end of 1985. Two hundred and thirty-seven customers would be added in 1984, leaving a slight excess capacity. It is to be expected that telephone rates will rise, perhaps sharply, as the national trend in divestitures of local phone companies from the AT&T organization continues.

3.5.5.1.2.3 Kimball, Nebraska

Systemwide growth in United Telephone's service area has been about 2.2 percent per year. Should that rate of growth continue, 157 new customers would be added to Kimball by 1986, exhausting existing capacity. Presumably, the company will judge whether its growth rate is continuing and will upgrade its capacity by 1985 if growth continues. The size of such an expansion that

Table 3.5.5-1

BASELINE AND PROJECT-INDUCED RESIDENTIAL TELEPHONE CUSTOMERS
IN THE CHEYENNE URBAN AREA

Customer Information	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Baseline Conditions										
1) Customers	33,780	34,557	35,456	36,626	37,798	38,932	40,100	41,303	42,542	43,818
2) Annual Customer Growth, %	1.8	2.3	2.6	3.3	3.2	3.0	3.0	3.0	3.0	3.0
3) Annual Installations	597	777	899	1,170	1,172	1,134	1,168	1,203	1,239	1,276
Project Conditions										
4) Induced Population		206	1,026	2,047	2,363	2,156	2,092	1,044	925	925
5) Induced Customers		103	513	1,024	1,182	1,078	1,046	522	463	463
6) Induced Installations		103	410	512	158	-104	-32	-524	-59	0
Baseline and Project										
Total Customers (1+5):	33,780	34,763	35,969	37,650	38,980	40,010	41,146	41,825	43,005	44,281
Net Installations (3+6):	597	880	1,309	1,682	1,330	1,030	1,136	679	1,180	1,276

Source: Mountain Bell 1983.

United Telephone will judge to be appropriate cannot be currently predicted (July 1983).

3.5.5.1.2.4 Pine Bluffs, Wyoming

Mountain Bell projects customer increases in Pine Bluffs averaging 1.8 percent over the next 5 years without the project. If this occurs, 66 customers would be added by 1988, exhausting existing capacity. Presumably, Mountain Bell will judge whether its growth rate is continuing and will ugrade its capacity by 1987 if growth continues. The size of the expansion that Mountain Bell will judge appropriate cannot be currently predicted (July 1983).

3.5.5.1.2.5 Scottsbluff, Nebraska

While population growth over the baseline period (1983 to 1992) has been projected to be 0.5 percent per year for Scottsbluff, United Telephone has experienced a 2.2 percent annual growth in new customers over the last several years. Should that rate continue, 818 new customers would be added by 1987, exhausting existing capacity. Presumably, the company will judge whether its growth rate is continuing and will upgrade its capacity by 1986 if growth continues (despite the lower population growth projected in this study). The size of the expansion that United Telephone will judge to be appropriate cannot be currently predicted (July 1983).

3.5.5.1.2.6 Torrington, Wyoming

Should the rate of growth experienced recently by United Telephone take place in Torrington, 190 customers would be added by 1985, exhausting existing capacity. The company will have to judge whether its growth rate is continuing, and it will obviously upgrade its capacity before 1985 if growth continues. The size of expansion the company will judge to be appropriate cannot be currently predicted (July 1983). The projected growth rate used in this work has been 1.4 percent (76 to 78 people per year). At that rate, 190 customers would not be added until 1986.

3.5.5.1.2.7 Wheatland, Wyoming

Mountain Bell projects annual customer increases averaging slightly over 1 percent through the next 5 years. If this occurs and continues, Mountain Bell's existing central office capacity in Wheatland would not be exhausted until well after 1992.

3.5.5.2 Proposed Action

3.5.5.2.1 Cheyenne Urban Area

3.5.5.2.1.1 F.E. Warren AFB Requirements

During the construction period (1984 to 1989) there will be a requirement for 500 to 800 additional telephones at F.E. Warren AFB. These phones will be used by both the construction contractors and the Site Activation Task Force to help direct and coordinate the construction activities on and off the base. Thus, during construction the number of base telephones will more than double. Following construction, the long-term operational need for additional

telephones will drop to 100 to 150. This represents a 20 to 30 percent increase over existing conditions. As planning and design of specific project support facilities at F.E. Warren AFB continue, more accurate phone requirements for the base will be developed.

Additional in-dial and out-dial telephone trunkline needs at F.E. Warren AFB will require new communication cable to be strung into the base. Depending on base requirements, still being determined, the switching facility in Building 65 may also need to be expanded by Mountain Bell.

3.5.5.2.1.2 Other Requirements

Based on local experience, Mountain Bell has recommended a factor of two persons per new customer to be applied to the project-induced population in Cheyenne. Table 3.5.5-1 showed the project-induced population by year and the estimated number of telephone service lines associated with the influx. It can be seen that in terms of the number of new customers, 1986 represents the year of highest impact. In that year nearly 512 new customers are estimated to be added in addition to a baseline growth of 1,170. This represents a 44 percent increase in new phone installations for that year over the baseline rate. In 1984, 1985, and 1987 the growth rates will be 13, 45, and 14 percent, respectively. The years 1988 to 1990 will result in a loss of 719 customers associated with the project. This will be compensated by continuing baseline growth in Cheyenne for a net gain of 4,025 customers during this period. In summary, there will be an increase in the annual rate of new residential phone installations in the years 1984 to 1987 and a reduction of that rate in the latter part of the decade. The increase in Cheyenne Urban Area customers over baseline conditions will peak in 1987 with a 3.1-percent growth. Although this is not a large increase, the telephone system will be impacted. The rate of annual new phone installations will peak in 1985, especially since the needs at F.E. Warren AFB will increase greatly during the same period. Expansions to the central office equipment will probably be needed sooner than is currently planned by Mountain Bell. The installation charges and monthly rates charged by the company to its customers are already designed to recover such periodic costs for capacity expansion. No increase in customer rates is expected to result from this expansion (Mountain Bell 1983).

Mountain Bell needs as much as 2 years lead time to plan for system expansions in an efficient and economic manner. Close liaison between the Air Force and Mountain Bell will assure the provision of telephone services.

Bell has indicated that the installation of facilities at F.E. Warren AFB to support 500 to 800 temporary telephones during the construction period may require special arrangements. One approach may be to install temporary cable and base switching facilities that could be removed once the project is completed. Since use for this equipment is short-lived, Bell may require direct reimbursement for the labor involved in system expansion. These details will need to be worked out as planning for the project progresses.

3.5.5.2.2 All Other Communities

All other communities in the Region of Influence have existing telephone equipment in place, or plans for expansion are underway such that no impacts on the three telephone companies are predicted. Growth induced by the project everywhere but in the Cheyenne Urban Area will be so low that telephone companies will be able to absorb the new customers with only negligible operational changes and no project-induced changes to baseline rate structures.

3.6 Summary of Impacts

3.6.1 Impact Matrix

Figure 3.6.1-1 summarizes all the utilities impacts identified. All impacts, except telephone service needs at F.E. Warren AFB, will be local and do not have site-specific or regional relevance. The site-related impact regarding the F.E. Warren AFB telephone cable capacity also has relevance in the local infrastructure to which these facilities are connected.

In all cases, impacts that are significant will be short-term impacts. This means they will occur, and it has been assumed that they will be mitigated, during the baseline period (1983 to 1990).

Finally, it should be noted that the low but significant rating for Cheyenne's (baseline) wastewater treatment capacity was given a low rating because the project's impact will be low if the current 201 Plan for capacity expansion at Dry Creek and abandonment of the South Cheyenne plant is implemented virtually immediately. If that is not the case, the project will merely exacerbate the already deteriorated treatment capacity at South Cheyenne and add more flow to the Dry Creek plant, which, by virtue of receiving more flow from Crow Creek as the years go on, will be reaching its current capacity as well. Unquestionably, implementation of the 201 Plan, which is already needed for baseline conditions, will involve a high impact on the local community, even with funding support from the state and federal governments. But it is worth noting that local officials are eager to proceed with the indicated improvements, despite the local funding impacts, and they anxiously await final funding approvals and the beginning of necessary construction.

3.6.2 Aggregation of Elements, Impacts, and Significance

All impacts on communitywide utilities will occur and should be mitigated during the early, short-term construction and check-out period of the project (i.e., prior to 1992). This results because they will all be caused by the relatively high inmigrant populations in the early, short-term period. For the indefinite, long-term future after 1992, the project-related workers and their families will be far lower in number, and the impacts the earlier inmigrants may have caused will all have been mitigated. By 1992 all utilities should have sufficient capacities to permit assimilation of the small, long-term, project-related populations. Also, every utilities impact identified for the short-term period will be negligible to low in size. The aggregated utilities impact rating at the site (only at F.E. Warren AFB in this case and not in the DA) will be negligible and will not be significant. The aggregated local impact on utilities, on the other hand, was rated significant, because the significance of wastewater impacts in Cheyenne is so dominant and compelling.

LEGEND		ADVERSE IMPACTS	SIGNIFICANT ADVERSE IMPACTS
LEVEL OF IMPACT*	LOW	○	●
	MODERATE	○	●
	HIGH	○	●
POTENTIAL BENEFICIAL EFFECTS			
*MEASURE OF THE AMOUNT OF ENVIRONMENTAL CHANGE			

	PROJECT IMPACTS					
	SHORT TERM			LONG TERM		
	SITE	LOCAL	REGIONAL	SITE	LOCAL	REGIONAL
UTILITIES		●				
Water Treatment and Distribution						
Wastewater		●				
Cheyenne Treatment Capacity		●				
Pine Bluffs Treatment Capacity						
F.E. Warren AFB Sewer		●				
Solid Waste		○				
Cheyenne Collection/Compaction Equipment		○				
All Other Communities						
Stormwater						
Cheyenne Urban Area Sewers						
All Other Communities						
Telephone Service						
F.E. Warren AFB	○	○				
Cheyenne Residential Service						
All Other Communities						

FIGURE 3.6.1-1 UTILITIES SUMMARY IMPACT MATRIX

In summary, the overall rating for the short-term utilities impacts is low but significant in the local setting. No regional or long-term impacts have been identified.

This overall rating has been reached through a professionally judged, qualitative averaging of the element and subelement ratings given in Figure 3.6.1-1. The short-term site impacts are rated negligible but not significant because most elements were not affected at the site level. The local-level impacts were rated low because many utilities subelements had low ratings and significant because Cheyenne's wastewater situation and early implementation of the 201 Facilities Plan are so highly critical.

Cheyenne Urban Area impacts are generally higher and often more significant than the impacts for all other communities. Site-level impacts for the Cheyenne Urban Area are considered negligible and not significant. The local-level impacts are low but significant, again because the significant rating for wastewater dominated the others. No other impacts are applicable except for the long-term local impacts which are negligible or nonexistent.

For all other communities there are only local impacts which are rated negligible and not significant overall.

The cable and road-siting alternatives and Defense Access Road upgrade modifications to the Proposed Action do not impact the utilities in urban areas, and the dispatch-station alternatives involve so few people that their impacts are all negligible and not significant.

3.7 Mitigation Measures

Potential mitigation measures that will be considered are identified below. One, some, or all of the mitigation measures may ultimately be selected. Each measure identifies the party responsible to implement, but not necessarily to pay for, the measure.

- The expedited implementation of the existing 201 Facilities Plan to provide reliable wastewater capacity for South Cheyenne. This mitigation measure will be effective in providing all the necessary treatment capacity needed for both baseline and project-related growth, and, if selected (as is locally anticipated), should be implemented by September 1985. The responsible agencies for implementing the mitigation measure are the agencies who submitted the 201 Facilities Plan: the City of Cheyenne (Board of Public Utilities), Laramie County (Cheyenne-Laramie County Regional Planning Office), and the South Cheyenne Water & Sewer District.

- The replacement with 15-inch pipe of certain sections of 12-inch sanitary sewer in Cheyenne which periodically surcharge as a result of high flows of wastewater into these pipes from upstream sewers on F.E. Warren AFB. This mitigation measure will be effective in stopping the periodic flooding of streets and basements, and if selected, should be implemented by September 1985. The responsible agency for implementing this mitigation measure is the Cheyenne Board of Public Utilities.

- The purchase of a garbage truck and a landfill compactor in 1986 (instead of 1987 and 1988, as required for baseline growth) for use by the City of Cheyenne. This mitigation measure will be effective in avoiding the borrowing of equipment from other city agencies after loads of solid waste reach 200 tons per day, and if selected, should be implemented by June 1986. The responsible agencies for implementing this mitigation measure are the City of Cheyenne's Department of Sanitation and the Department of Public Works, Division of Streets and Alleys.

3.8 Unavoidable Adverse Impacts

There will be no unavoidable adverse utilities impacts from the project.

3.9 Irreversible and Irretrievable Resource Commitments

The aggregate and cement associated with less than 4,000 feet of 15-inch concrete sanitary sewer and the roughly 4,500 feet of storm sewers ranging from 15 to 48 inches in diameter are the only resources to be irretrievably dedicated.

3.10 The Relationship Between Local Short-Term Use of Man's Environment and Maintenance and Enhancement of Long-Term Productivity

The mitigations suggested for utilities all involve the burial of new pipelines and telephone cable or the expansion of treatment capacity on already dedicated land. Hence, while the installation of new buried utilities will involve very short-term disturbances of the environment, these facilities will enhance man's ability to use his environment since they involve fixing existing problems with capacity that will accommodate all present and foreseeable future needs.

4.0

GLOSSARY

4.0 GLOSSARY

4.1 Terms

Acre-Foot: the volume of water that would cover 1 acre to a depth of 1 foot.

Aquifer: the water-bearing portion of subsurface earth material that yields or is capable of yielding useful quantities of water to wells.

Area of Concentrated Study: area(s) within the Region of Influence which will receive the majority of environmental impact attention. Environmental impact analysis was focused within the Area of Concentrated Study for this study of environmental impacts. The Area of Concentrated Study is defined for Utilities in Section 2.3.1.

Baseline: the existing and future-growth characterization of an area under no-project conditions.

Biochemical Oxygen Demand (BOD): the amount of dissolved oxygen, in milligrams per liter, used by microorganisms in the biochemical oxidation of organic matter.

Biota: all of the organisms of an area; the flora and fauna of a region.

BOD_5 or 5-Day Biochemical Oxygen Demand: the quantity of oxygen, in mg/l, used by microorganisms in the biochemical oxidation of organic matter during a 5-day period at 20^oC.

CAPDET: a computer simulation and cost analysis model promulgated by the EPA and the U.S. Army Corps of Engineers for the determination of needed capacity and for the estimation of costs for various waste treatment processes.

Clearwell: a storage tank or tanks for filtered water at a water treatment plant, normally located adjacent to the filter units. Typically the clearwell provides detention time to allow injected chlorine to disinfect the water.

Contact Basin: a tank within a water or waste treatment process in which coagulation/flocculation or other chemical or biochemical reactions are designed to occur.

Design Life: the anticipated useful life of a facility.

Developed: said of land, a lot, parcel, or area which has been built upon or has had public services installed prior to residential or commercial construction.

Digester Performance: the rate or amount of volume reduction achieved by biological treatment of waste sludge.

Direct Effects: effects resulting solely from project implementation.

Disinfection: the use of ultraviolet light or chemical or gaseous agents for the destruction of bacteria and viruses that cause waterborne diseases in man.

Effluent: wastewater discharged from a wastewater treatment facility.

Energy: the capacity for doing work; taking a number of forms which may be transformed from one into another, such as thermal, electrical, or chemical; in customary units, measured in kilowatt hours (kWh) or British thermal units (Btu).

Fecal Coliform Bacteria: a group of microorganisms found in the intestinal tracts of people and animals. Their presence in water indicates the likelihood of pollution and possibly dangerous bacterial contamination.

Household Size: the average number of individuals residing in a single dwelling unit.

Infiltration: the leakage of groundwater into a sewer from defective or deteriorating pipe joints.

Inflow: the entrance of stormwater runoff into a sanitary sewer through defective or deteriorating manhole structures or via the illicit connection of roof drains or street storm drains to sanitary sewers.

Inmigrants: all people relocating into a defined geographic area.

Level of Impact: for each environmental resource, such as utilities, specific definitions have been given for negligible, low, moderate, and high impacts for this study of environmental impacts.

Long-Term or (the) Long Term: denotes the steady-state operations phase of the project when a constant level of project employment is attained.

Long-Term Impact: after the construction phase; during full operation, after 1990.

Mean: a value that is computed by dividing the sum of a set of terms by the number of terms (i.e., average).

Milligram: one-thousandth of a gram.

Millimeter: one-thousandth of a meter.

Mitigations: methods to reduce or eliminate adverse project impacts.

Mobile Home: a single-family dwelling unit which is transportable in one or more sections, built on a permanent chassis, and designed to be used with or without a permanent foundation. Does not include travel trailers or recreational vehichles.

Model: a computerized set of equations which together express the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions; e.g., pipe hydraulics, groundwater movement, erosion-sedimentation processes, or water quality behavior.

Noncompliance: action contradicting a specified procedure or causing results outside specified limits.

Peak Year: the year in which some particular project-related effect, e.g., total employment, is greatest.

Preliminary Treatment: the first processes at a wastewater treatment facility to remove coarse debris from the wastewater. Typically, the treatment involves bar or mechanical screening, grit removal, and sometimes comminution.

Pressure Zone: a water service area delineated by a range of water pressures at which water is delivered to a customer's connection point. Typically, pressure zone boundaries indicate areas with water pressure below 40 psi and above 100 psi.

Qualitative Measures: measures relating to inherent, intangible features that are hard to quantify.

Quantitative Measures: measures that assess the absolute degree of association between variables.

Reclamation: the process of restoration of an area which has been disturbed, or the treatment to restore continued utility of a waste substance.

Region of Influence: the largest region that would be expected to receive measurable impacts from the Proposed Action.

Secondary Treatment: the reduction of biochemical oxygen demand in wastewater by aerobic biological processes and sedimentation.

Short-Term Impact: project-related effects occurring during the construction period, up to 1990.

Significance: the importance or context features of an identified impact. It is important to note that a high impact may not be significant, while a low impact may. Significance is an either/or determination: the level of impact described either is significant or is not significant.

Site Specific: conditions characteristic of a geographically defined location that may vary considerably from characteristics of adjacent locations or the characteristics of a larger area within which the location in question is contained.

Storm Water Management Model: a computer model promulgated by the EPA for hydraulic and quality simulation of storm, sanitary, and combined sewers, treatment processes, and receiving waters; known as the SWMM model.

Subdivision: an area of land for which a plat has been approved.

Subdivision Regulations: a public document which establishes requirements for land development or use.

Surcharge: the condition within a gravity sewer wherein flow changes from nonpressurized to pressurized flow. Typically this involves the water level rising above the top of a sewer line in manholes, sometimes causing flooding of streets above.

Vacancy Rate: the average number of single-family, multifamily, or mobile homes that are unoccupied at any given time.

WATSIM: a computer model for the simulation of water distribution pipe networks and storage volumes, plus appurtenances.

4.2 Acronyms

ACS	Area of Concentrated Study
AFB	Air Force Base
AFRCE.	Air Force Regional Civil Engineer
BOD	Biochemical Oxygen Demand
BOD_5	5-Day Biochemical Oxygen Demand
CAPDET	Computer Assisted Design and Evaluation of Wastewater Treatment. Systems model whose acronym stands for Capacity Determination.
CBPU	Cheyenne Board of Public Utilities
DA	Deployment Area
DEIS	Draft Environmental Impact Statement
EIAP	Environmental Impact Assessment Process
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPTR	Environmental Planning Technical Report
FEIS	Final Environmental Impact Statement
FY	Fiscal Year
LOI	Level of Impact
NEPA	National Environmental Policy Act of 1969
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
ROI	Region of Influence
SCS	Soil Conservation Service
SCW&SD	South Cheyenne Water & Sewer District
SS	Suspended Solids
SWMM	Storm Water Management Model
TDS	Total Dissolved Solids
USAF	United States Air Force
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WATSIM	Water (system) Simulation (model)
WDEQ	Wyoming Department of Environmental Quality

4.3 Units of Measurement

acre	acre
acre-ft	acre-feet
acre-ft/yr	acre-feet per year
^{o}C	degrees Celsius
cf	cubic foot
cfs	cubic feet per second
cm	centimeter
cy	cubic yard
^{o}	degrees (temperature)
^{o}F	degrees Fahrenheit
ft	foot or feet
g	gram
gal	gallon or gallons
gpcd	gallons per capita per day
gph	gallons per hour
gpm	gallons per minute
in/hr	inches per hour
kg	kilogram
km	kilometer
km/hr	kilometer per hour
kW	kilowatt
kWh	kilowatt hour
lb	pound or pounds
lb/cf	pounds per cubic foot
lb/cy	pounds per cubic yard
m	meter
mg	milligrams
MG	million gallons
mgd	million gallons per day
mg/l	milligrams per liter
mi	mile
mm/hr	millimeters per hour
mph	miles per hour
m/sec	meter per second
MW	megawatt
ppcd	pounds per capita per day
psi	pounds per square inch
sq ft	square feet
sq mi	square mile
T/day	tons per day

REFERENCES CITED AND REVIEWED

5.0 REFERENCES CITED AND REVIEWED AND PERSONAL COMMUNICATIONS

5.1 Documents

American Public Works Association, Institute for Solid Wastes
1970 Municipal Refuse Disposal (third ed.). Public Administration Service, Chicago.

Baker, Sweeney and Associates
1982 Investigation and Conceptual Study for Rehabilitation of the Sanitary Sewer System. Prepared for F.E. Warren AFB, Scottsbluff, Nebraska.

Banner Associates, Inc.
1982 201 Facilities Plan Final Report: City of Cheyenne, South Cheyenne Water and Sewer Districts, Laramie County. Laramie, Wyoming.

Banner Associates, Inc.
1983 Report on Crow Creek Watershed Raw Water Delivery System Evaluation, Prepared for URS-Berger, Laramie, Wyoming.

BRW/Noblitt, Inc., and Wright-McLaughlin Engineers
1979 Dry Creek Major Drainageway Planning (Vols. I and II). City of Cheyenne and Laramie County.

Cheyenne, City Engineer's Office
circa. 1980 Cheyenne Storm Water Management Planning Manual. Cheyenne, Wyoming.

Cheyenne and Laramie County
1979 Subdivision Regulations. Administered by the Cheyenne - Laramie County Regional Planning Office.

Cheyenne and Laramie County
1982 Zoning Ordinance. Re-adopted from 1971 version.

Nebraska Department of Environmental Control
1981 Rules and Regulations Pertaining to Solid Waste Management, as amended, November 3, 1981.

Plambeck, Maury
1982 Waste Management Study Group Report. Unpublished material, Sanitation Department, Cheyenne.

Richardson, Alan K.
1983 Estimating Water Storage Requirements. Paper presented at Water Distribution System Analysis and Design Workshop, University of Wisconsin, Madison.

Steel, E.W., and T.M. McGhee
1979 Water Supply and Sewerage, Fifth Edition, McGraw-Hill Book Company, New York.

URS Company
1979 City of Thornton Comprehensive Water Utility Master Plan. Unpublished material, reviewed at URS Company Library.

U.S. Department of Commerce
1974 National Oceanic and Atmospheric Administration Atlas 2, Precipitation-Frequency Atlas of the Western United States, Wyoming (Vol. II). Silver Spring, Maryland.

U.S. Department of Commerce
1982 Local Climatological Data - Annual Summary with Comparative Data, for Cheyenne, Wyoming, 1981. Asheville, North Carolina.

Water Pollution Control Federation and the American Society of Civil Engineers
1977 Wastewater Treatment Plant Design. Manual of Practice No. 8, Washington, DC and New York.

Wyoming Department of Environmental Quality
1975 Solid Waste Management Rules and Regulations. Cheyenne.

Wyoming Department of Environmental Quality
1983 Wyoming Oil and Hazardous Substances Pollution Contingency Plan. Cheyenne.

5.2 Personal Communications

Bronco Disposal Service
1983 Personal communication with company owner, Cheyenne, Wyoming.

Cheyenne Board of Public Utilities
1983 Personal communication with the Director and staff.

Cheyenne, City of, Department of Public Works
1983 Personal communication with the City Engineer, the Director of Streets and Alleys, Director of the Department of Sanitation, and other staff.

Cheyenne, Laramie County Regional Planning Office
1983 Personal communication with the Planning Director and staff.

Chugwater, City of
1983 Personal communication with the Water Commissioner.

Chugwater Telephone Company,
1983 Personal communication with company personnel.

Colorado Landfill, Inc.,
1983 Personal communication with the staff, Greeley, Colorado.

EPA (United States Environmental Protection Agency)
1983 Personal communication with the Freedom-of-Information Officer, Kansas City, MO, Region 7, and the Toxic & Hazardous Waste Office.

F.E. Warren AFB
1983 Personal communication with staff Environmental Engineer.

Fort Collins, City of
1983 Personal communication with the Department of Environmental Health.

Fox Sanitation Company,
1983 Personal communication with company owner, Cheyenne, Wyoming.

Gering, City of
1983 Personal communication with the City Administrator.

Gering, City of
1983 Personal communication with staff of the City Water & Sewer Department.

Goshen, County of
1983 Personal communication with the County Sanitarian.

Greeley, City of
1983 Personal communication with staff of the Water Department.

Heimbuck's Disposal Service, Inc.,
1983 Personal communication with the owner, Gering, Nebraska.

Kennedy Engineering
1983 Personal communication with the owner, Wheatland, Wyoming.

Kimball, City of
1983 Personal communication with the City Administrator, Kimball, Nebraska.

Kimball, City of
1983 Personal communication with the Landfill Operator, Kimball, Nebraska.

Laramie, City of
1983 Personal communication with staff of the Department of Sanitation and the Superintendent for Solid Waste Disposal.

Laramie, City of
1983 Personal communication with staff of the Water & Wastewater Department.

LarCo Disposal Co.
1983 Personal communication with owner, Pine Bluffs, Wyoming.

Mountain Bell
1983 Personal communication with the Engineering Manager, Cheyenne, Wyoming.

Mountain Bell
1983 Personal communication with the Manager, Greeley-Fort Collins, Colorado.

Mountain Bell
1983 Personal communication with the Operations Manager, Laramie, Wyoming.

Nebraska Department of Environmental Control
1983 Personal communication with a Research Analyst.

Pine Bluffs, Town of, Utilities Office
1983 Personal communication with the Purchasing Agent.

Scottsbluff, City of
1983 Personal communication with the Sanitation Supervisor.

Scottsbluff, City of
1983 Personal communication with the Superintendent of the Sewer & Water Department.

South Cheyenne Water & Sewer District (SCW&SD)
1983 Personal communication with the Administrator and the Board of Directors.

Torrington Disposal Service
1983 Personal communication with the owner.

Torrington, Town of
1983 Personal communication with the Clerk-Treasurer.

Torrington, Town of
1983 Personal communication with the Director of Public Works and the Superintendent of Water & Sewers.

Torrington, Town of
1983 Personal communication with the Sanitation supervisor.

United Telephone System, Western Division
1983 Personal communication with the Vice President.

USAF Air Force Regional Civil Engineer (AFRCE)
1983 Personal communication with the Fire Protection Engineer.

Wells Engineers, Inc.,
1983 Personal communication with the Vice President, Gering, Nebraska.

Western Salvage, Inc.
1983 Personal communication with the staff, Kimball, Nebraska.

Wheatland, Town of
1983 Personal communication with the City Clerk relative to storm drainage facilities.

Wheatland, Town of
1983 Personal communication with the staff of the Water Sewer Department.

Wyoming Department of Environmental Quality
1983 Personal communications with the Southeast District Supervisor or Oil and Hazardous Substances Response.

Wyoming Department of Environmental Quality
1983 Personal communication with the staff of the Solid Waste Management Program.

Wyoming Department of Environmental Quality, Water Quality Division
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6.0

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6.0 LIST OF PREPARERS

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APPENDIX A

APPENDIX A
MATHEMATICAL MODEL DESCRIPTIONS

A.1 WATSIM Water Distribution System Simulator

The computer model known as WATSIM was originally developed by the private consulting firm, Systems Control, Inc., of Palo Alto, California. The model was developed for the U.S. Department of the Interior's Office of Water Resources Research in 1973. Since that time it has been made available through proprietary arrangements with Boeing Computer Services Company, a division of the Boeing Company.

WATSIM provides capacity for both steady-state and dynamic (hourly) assessments of a municipal water supply system's hydraulic behavior. In this study, only steady-state simulations were performed.

The computer code contains a number of expressions for computation of flow through a single pipe in a network, from which the user is free to select his favorite. In this case, the Hazen-Williams equation was selected, which is:

$$Q = 6.28 \times 10^{-4} CD^{2.63} (H/L)^{0.54}$$

in which Q = flow in cfs, C = the Hazen-Williams roughness coefficient (dimensionless, range = roughly 80 to 130), D = pipe diameter (inches), H = headloss in feet from one end of a pipe to the other, and L = pipe length (feet).

The model solves simultaneously both this expression for Q in the pipes and the algebraic sum of all flows into and away from a junction of pipes as being zero. Some of the outflows from selected junctions, of course, are the water demands, which are specified by the user as derived from data about population, firefighting demand rates, or commercial or industrial water usage.

From a simulation of the system under a series of worst-case demand conditions, both for the present and the future, the performance of individual facilities can be evaluated from the computer output, and performance information about the water supply system's strengths and deficiencies can be identified. In addition, any updates to corrective and/or expansion plans can be quickly tested for effectiveness by rerunning the model and viewing the new performance data.

The worst-case demand conditions usually imposed on the computer model of a water supply system are identified and explained below.

A maximum-day-demand analysis is performed to ensure that a full treated-water storage capacity is available prior to the maximum-hour design period. Ideally the storage facilities should be full and not contributing to the distribution network to meet maximum-day demands.

A maximum-day plus fireflow analysis provides a performance evaluation of the distribution system's ability to provide fireflows at a predetermined point at adequate volume and pressure. Normally the storage facilities are set at

half-full to simulate that the equalizing component has been used to meet maximum-hour demand rates that occurred during a maximum-day event.

The maximum-hour analysis provides a performance evaluation of the distribution system and storage facilities. Roughly speaking, the rate of outflow from the storage facilities should be capable of supplying the maximum-hour rate less the maximum-day rate over some design duration without depleting storage capacity by more than one-half.

The replenishment analysis tests the ability of the distribution system to replace the volume that the storage facilities contributed during the day. The analysis is run under a minimum water demand loading to simulate storage being replenished during the late-night/early-morning period.

Ideally, all the following data would be collected, reviewed, and arrayed to prepare the input for the computer model:

1. Overall mapping of the distribution system, which would indicate pipe sizes and lengths and locations of valves and hydrants.

2. As-built drawings of any pumping and treated-water storage facilities, showing storage facility floor and overflow elevations.

3. Normal operating schedule and H-Q (head-flow) curves for all pumping facilities feeding directly into the distribution system.

4. A topographic map of the city or a list of benchmarks and intersection elevations.

5. Compiled data on fire flow tests performed in recent years.

6. Treated-water analyses and information on age and condition of existing transmission mains.

7. A zoning map, locating commercial, industrial, and multiple and single-family residential districts.

8. Past population records and future projections.

9. Water consumption patterns for average day, maximum day and peak hour.

10. A breakdown of total demand -- unaccounted-for, residential, commercial, and industrial demands.

11. Distributed present water demands.

12. A skeletonized grid of the water distribution system.

13. Concentrated water demands placed at nodes in the skeletonized grid.

14. Hazen-Williams roughness values (Cs) for each pipe.

The model then computes and arrays the flows in each pipe, the pressures at each junction, and the volume of water stored or the drain rate of flow from each storage facility.

A.2 EPA's Storm Water Management Model (SWMM)

The computer model known as SWMM was first developed for the U.S. Environmental Protection Agency in 1971 by a consortium of three parties: the University of Florida (Environmental Engineering Department), Metcalf & Eddy Engineers, and Water Resources Engineers, Inc. (later purchased by and now a part of Camp Dresser & McKee Inc.).

The model has been updated many times, principally by its original developers, and it remains available through EPA's Athens, Georgia, laboratory.

The SWMM model was developed to simulate both flow and quality of sewage in combined sewer systems, which includes the flow and quality of urban runoff and those of sanitary wastewater.

In its original version the transport of wastewater was simulated under steady, uniform flow assumptions, which means the flow is everywhere flowing by gravity and hydraulic control remains upstream. This is another way of saying that surcharged or pressurized flow was not included, and the assumption was that every pipe's flow was independent of every other pipe's flow and behaving according to the Manning equation:

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

in which V = velocity (ft/sec), n = Manning roughness coefficient ($ft^{1/6}$), R = hydraulic radius (ft), and S = slope of the pipe (ft/ft).

Though they were not used in this work, many refinements have been added to this model to permit looped sewers to be analyzed and to allow surcharge to be simulated.

In this project, SWMM was used to simulate both sanitary sewers and storm sewers, which in Cheyenne are separate systems.

When surcharging was encountered in either system, an option in (the original version of) the hydraulic part of SWMM was used, in which the model automatically increased the diameter of the downstream pipe until it could hold all the water being fed into it from an upstream pipe. This option proved particularly useful for the successful simulation of Cheyenne's developed area storm sewers.

No quality simulations (which remain weakly supported options in SWMM) were attempted. (The quality of sanitary sewage was known from measurable records at waste treatment plants, and the quality of storm runoff was not needed.)

A.3 CAPDET Waste Treatment Simulator and Cost Estimator

The computer model known as CAPDET was originally developed by the U.S. Army Corps of Engineers' Waterways Experiment Station in Vicksburg, Mississippi, in 1974. In 1976 the Corps and the EPA entered an agreement to upgrade and expand the model so that both agencies could use it for their separate aims. The Civil Engineering Department of the University of Mississippi continues to supply the model for a modest fee.

CAPDET stands loosely for Computer-Assisted Procedure for the Design and Evaluation of Wastewater Treatment Systems, which is descriptive of what it does. In a two-step process, the model computes necessary sizes for a number of treatment units in a user-specified treatment process (such as activated sludge); and then, from rather grossly summarized national data and relationships among them, it computes an estimated cost for a plant of that type and size.

The model was most useful in this project for computing the sizes of various parts of a plant necessary to treat flows for current and future years to meet effluent specifications. The cost estimation equations were used only as general guides, and as noted in the report, the cost results should be viewed as nothing more than that.